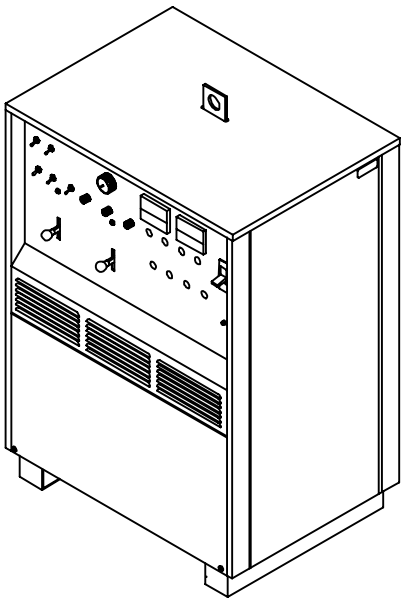
Miller®

November 1994 Form: OM-350T

Effective With Serial No. KD419169

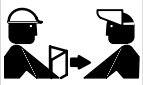
OWNER'S MANUAL



Syncrowave® 500

- CC, AC/DC Welding Power Source
- For GTAW and SMAW Welding
- 500 Amperes, 40 Volts AC At 60% Duty Cycle
- Uses Single-Phase Input Power
- Overload Protection For 115 Volts AC Control Circuit
- Built-In High Frequency With Intensity Control
- AC Balance Control
- For Options And Accessories, See Rear Cover

- Read and follow these instructions and all safety blocks carefully.
- Have only trained and qualified persons install, operate, or service this unit.
- Call your distributor if you do not understand the directions.



- Give this manual to the operator.

- For help, call your distributor
- or: MILLER Electric Mfg. Co., P.O. Box 1079, Appleton, WI 54912 414-734-9821

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EMF INFORMATION

NOTE ☞ *Considerations About Welding And The Effects Of Low Frequency Electric And Magnetic Fields*

The following is a quotation from the General Conclusions Section of the U.S. Congress, Office of Technology Assessment, *Biological Effects of Power Frequency Electric & Magnetic Fields – Background Paper*, OTA-BP-E-53 (Washington, DC: U.S. Government Printing Office, May 1989): ". . . there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields can interact with, and produce changes in, biological systems. While most of this work is of very high quality, the results are complex. Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustrating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoid potential risks."

To reduce magnetic fields in the workplace, use the following procedures:

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cables around the body.
4. Keep welding power source and cables as far away as practical.
5. Connect work clamp to workpiece as close to the weld as possible.

About Pacemakers:

The above procedures are among those also normally recommended for pacemaker wearers. Consult your doctor for complete information.

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SECTION 1 – SAFETY INFORMATION

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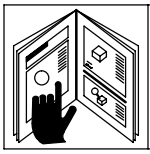
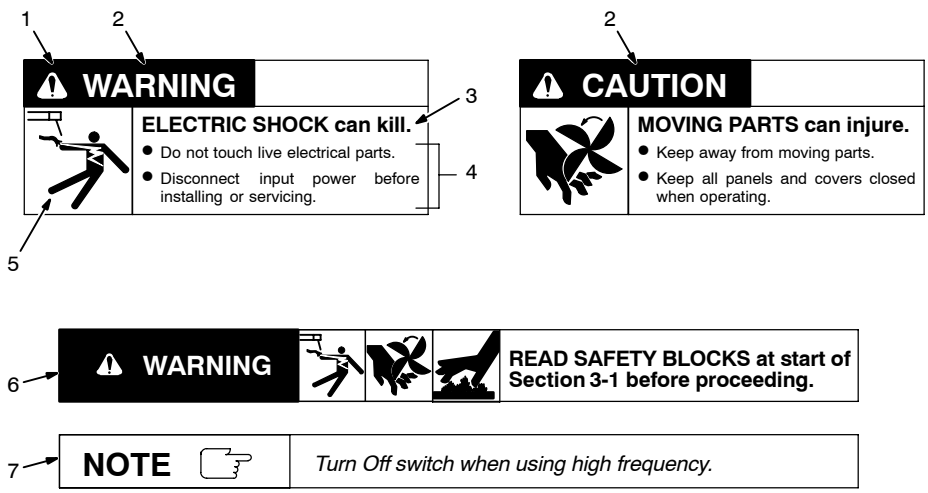


- Read all safety messages throughout this manual.
- Obey all safety messages to avoid injury.
- Learn the meaning of WARNING and CAUTION.



1 Safety Alert Symbol

2 Signal Word

WARNING means possible death or serious injury can happen.

CAUTION means possible minor injury or equipment damage can happen.

3 Statement Of Hazard And Result

4 Safety Instructions To Avoid Hazard

5 Hazard Symbol (If Available)

6 Safety Banner

Read safety blocks for each symbol shown.

7 NOTE

Special instructions for best operation – not related to safety.

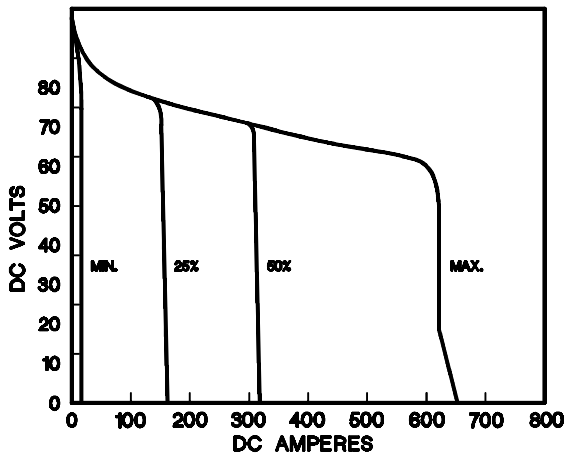
Figure 1-1. Safety Information

SECTION 2 – SPECIFICATIONS

Table 2-1. Welding Power Source

Specification	Description
Type Of Output	Constant Current (CC), Alternating Current (AC) Or Direct Current (DC)
Welding Processes	Gas Tungsten Arc (GTAW), Shielded Metal Arc Welding (SMAW)
Open-Circuit Voltage	80 Volts
Amperage Range	25 – 625
Overall Dimensions	See Figure 3-3
Weight	Net: 887 lb (402 kg); Ship: 902 lb (409 kg)
Rated Weld Output	NEMA Class I (60) – 500 Amperes, 40 Volts AC At 60% Duty Cycle (See Section NO TAG)
Type Of Input Power	Single-Phase; 200, 230, 460, Or 575 Volts AC; 60 Hz
Input Amperes At AC Balanced Rated Output	206 A At 200 V, 180 A At 230 V, 90 A At 460 V, 72 A At 575 V
Input Amperes Used While Idling	42 A At 200 V, 36.5 A At 230 V, 18.3 A At 460 V, 14.6 A At 575 V
KVA/KW Used At Rated Output	41.4 kVA/26 kW
KVA/KW Used While Idling	8.4 kVA/1.3 kW

2-1. Volt-Ampere Curves



The volt-ampere curves show the minimum and maximum voltage and amperage output capabilities of the welding power source. Curves of other settings fall between the curves shown.

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Figure 2-1. Volt-Ampere Curves

2-2. Duty Cycle

⚠ CAUTION

WELDING LONGER THAN RATED DUTY CYCLE can damage unit and void warranty.

- Do not weld at rated load longer than shown below.

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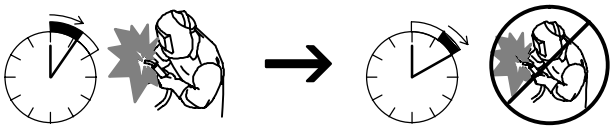
Definition

Duty Cycle is percentage of 10 minutes that unit can weld at rated load without overheating.

60% Duty Cycle At 500 Amperes



6 Minutes Welding

4 Minutes Resting

Chart

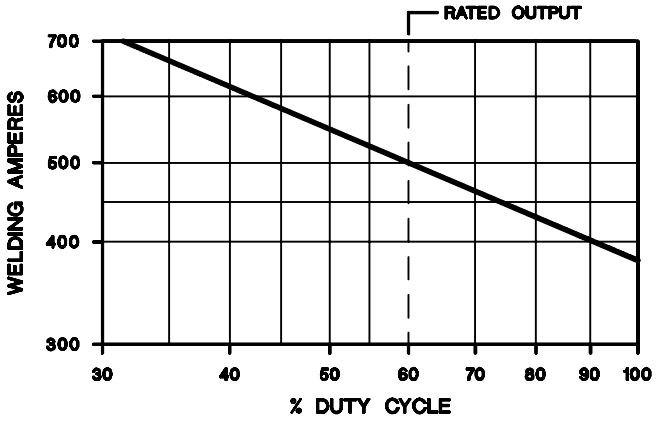


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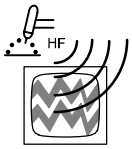
Figure 2-2. Duty Cycle

SECTION 3 – INSTALLATION

⚠ WARNING



HIGH-FREQUENCY RADIATION can interfere with radio navigation, safety services, computers, and communications equipment.

- Have only qualified person familiar with electronic equipment perform this installation.
- Read and follow entire Section 7 for proper location and installation requirements for high-frequency equipment before installing unit.

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3-1. Typical Process Connections

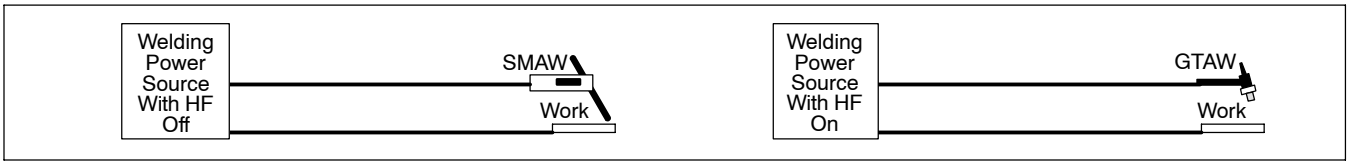

Figure 3-1. Typical Process Connections

3-2. Selecting A Location And Moving Welding Power Source

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Disconnect input power conductors from de-energized supply line BEFORE moving welding power source.

FIRE OR EXPLOSION can result from placing unit on, over, or near combustible surfaces.

- Do not locate unit on, over, or near combustible surfaces.
- Do not install unit near flammables.

BLOCKED AIRFLOW causes overheating and possible damage to unit.

- Do not block or filter airflow.

Warranty is void if any type of filter is used.

FUMES can be hazardous; LACK OF FRESH AIR AND PROPER VENTILATION can be harmful.

- Do not breathe welding fumes.
- Place unit only where there is a good fresh air supply and proper ventilation.

FALLING EQUIPMENT can cause serious personal injury and equipment damage.

- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift the unit.

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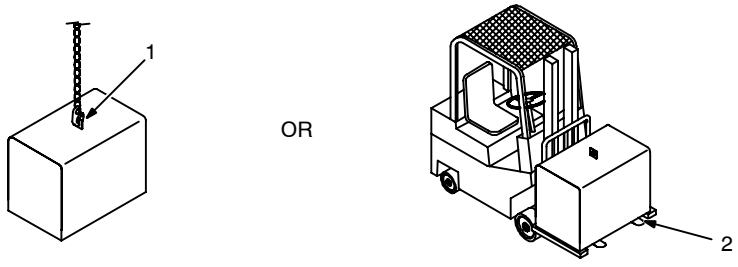
Movement



1 Lifting Eye

2 Lifting Forks

Use lifting eye or lifting forks to move unit.

If using lifting forks, extend forks beyond opposite side of unit.

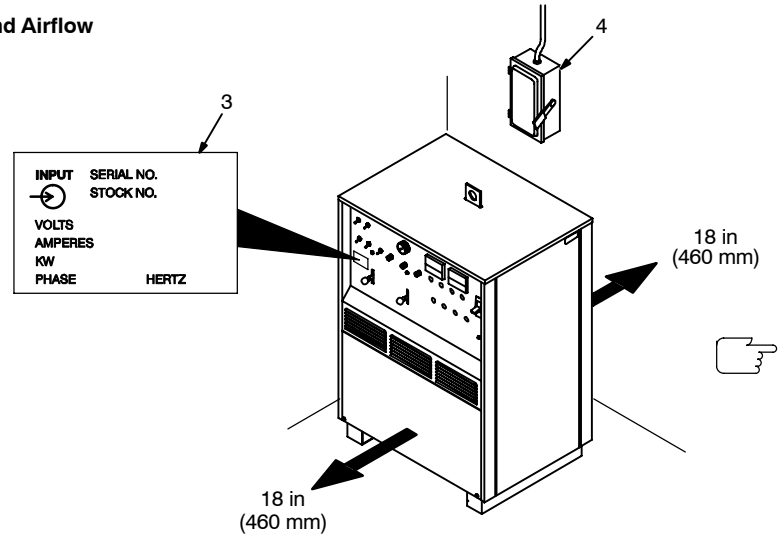
3 Rating Label

Use rating label to determine input power needs.

4 Line Disconnect Device

Locate unit near correct input power supply.

Location And Airflow

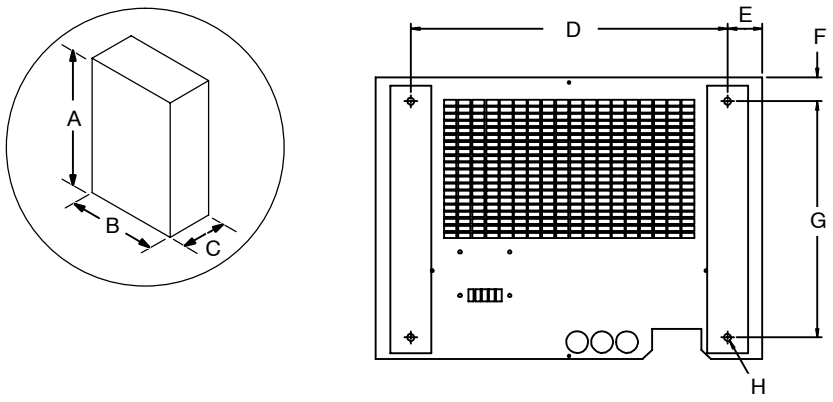


Special installation may be required where gasoline or volatile liquids are present – see NEC Article 511 or CEC Section 20.

ssb9.1 5/94 – ST-800 402 / ST-127 872-A

Figure 3-2. Movement And Location Of Welding Power Source

NOTE ☞ *Overall dimensions (A, B, and C) include lifting eye, handles, hardware, etc.*

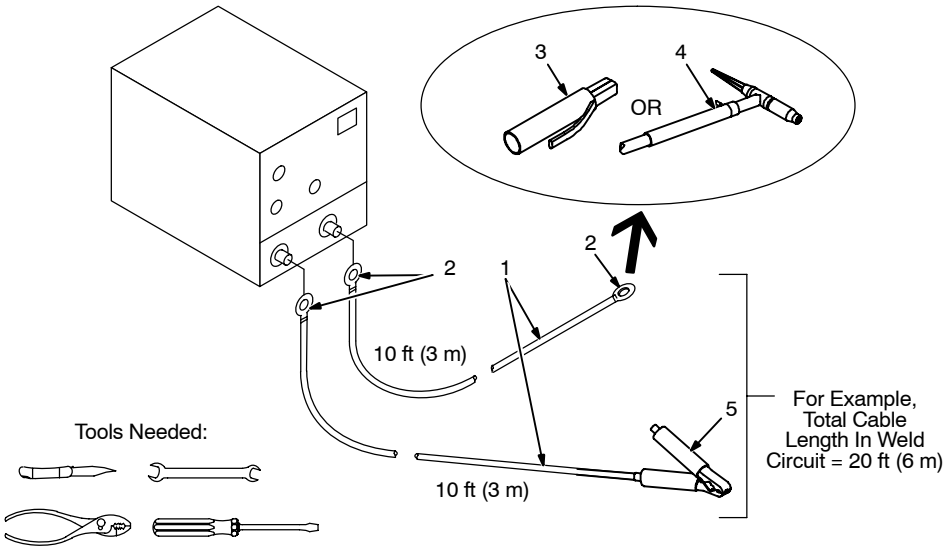


	Inches	Millimeters
A	47	1193
B	31-1/4	794
C	22-3/4	577
D	25-1/2	648
E	2-13/16	71
F	1-15/16	49
G	19	483
H	9/16 Dia 4 Holes	14 Dia 4 Holes

ST-800 338

Figure 3-3. Overall Dimensions And Base Mounting Hole Layout

3-3. Selecting And Preparing Weld Output Cables



1 Weld Output Cable

Determine total cable length in weld circuit and maximum welding amperes. Use Table 3-1 to select proper cable size.

Use shortest cables possible.

Do not use damaged cables.

2 Terminal Lug

Use lugs of proper amperage capacity and hole size for connecting to work clamp or electrode holder, and weld output terminals.

3 Insulated Electrode Holder

4 GTAW Torch

Install according to manufacturer's instructions.

5 Work Clamp

Install onto work cable.

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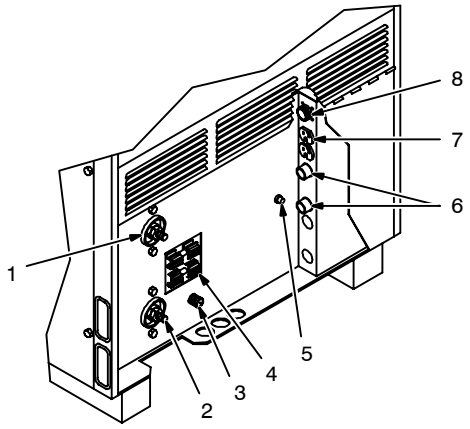
Figure 3-4. Selecting And Preparing Weld Output Cables

Table 3-1. Weld Cable Size*

Welding Amperes	Total Cable (Copper) Length In Weld Circuit Not Exceeding							
	100 ft (30 m) Or Less		150 ft (45 m)	200 ft (60 m)	250 ft (70 m)	300 ft (90 m)	350 ft (105 m)	400 ft (120 m)
	10 To 60% Duty Cycle	60 Thru 100% Duty Cycle	10 Thru 100% Duty Cycle					
100	4	4	4	3	2	1	1/0	1/0
150	3	3	2	1	1/0	2/0	3/0	3/0
200	3	2	1	1/0	2/0	3/0	4/0	4/0
250	2	1	1/0	2/0	3/0	4/0	2-2/0	2-2/0
300	1	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-3/0
350	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-3/0	2-4/0
400	1/0	2/0	3/0	4/0	2-2/0	2-3/0	2-4/0	2-4/0
500	2/0	3/0	4/0	2-2/0	2-3/0	2-4/0	3-3/0	3-3/0
600	3/0	4/0	2-2/0	2-3/0	2-4/0	3-3/0	3-4/0	3-4/0

*Weld cable size (AWG) is based on either a 4 volts or less drop or a current density of at least 300 circular mils per ampere. S-0007-D

3-4. Lower Front Panel



1 Work Output Terminal

2 Electrode Output Terminal

3 High Frequency Intensity Control (See Figure 4-10)

4 Spark Gaps (See Section 5-3)

5 Circuit Breaker CB1 (See Section 5-2)

6 Gas Valve Fittings

7 115 VAC Duplex Receptacle

8 Remote Contactor And Current Control Receptacle

Ref. ST-144 405-B

Figure 3-5. Lower Front Panel

3-5. Installing Gas Supply

⚠ WARNING

CYLINDERS can explode if damaged.

- Keep cylinders away from welding and other electrical circuits.
- Never touch cylinder with welding electrode.
- Always secure cylinder to running gear, wall, or other stationary support.

BUILDUP OF SHIELDING GAS can harm health or kill.

- Shut off shielding gas supply when not in use.

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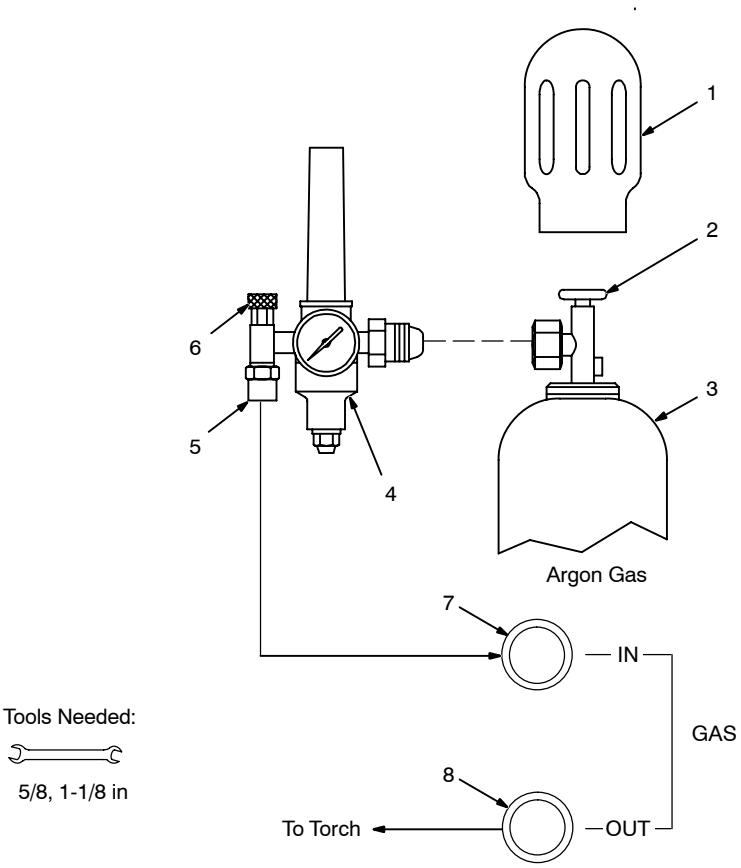

Tools Needed:

5/8, 1-1/8 in

Chain cylinder to running gear, wall, or other stationary support so it cannot fall and break off valve.

1 Cap

2 Cylinder Valve

Remove cap, stand to side of valve, and open valve slightly. Gas flow blows dust and dirt from valve. Close valve.

3 Cylinder

4 Regulator/Flowmeter

Install so face is vertical.

5 Gas Hose Connection

Fitting has 5/8-18 right-hand threads. Obtain and install gas hose.

6 Flow Adjust

Typical flow rate is 15 cfh (cubic feet per hour).

Make sure flow adjust is closed when opening cylinder to avoid damage to the flowmeter.

7 Gas In Fitting

8 Gas Out Fitting

The gas In and gas Out fittings have 5/8-18 right-hand threads.

Connect hose as shown.

Close access door.

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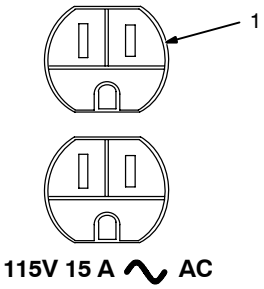
Figure 3-6. Shielding Gas Connections

3-6. 115 Volts AC Duplex Receptacle



1 115 Volts AC Duplex Receptacle

This welding power source supplies up to 15 amperes of 115 volts ac power.

Receptacle is protected from overload by circuit breaker CB1 (see Section 5-2).

Figure 3-7. 115 Volts AC Duplex Receptacle

3-7. Connecting To Weld Output Terminals

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn Off welding power source, and disconnect input power before making any weld output connections.

SERIOUS ELECTRIC SHOCK OR FIRE CAN RESULT FROM WELD CURRENT ON CASE and in ground conductor.

- Do not let torch cable adapter hit screwheads, access door, case, or any parts.
- Install adapter as shown in Figure 3-8.

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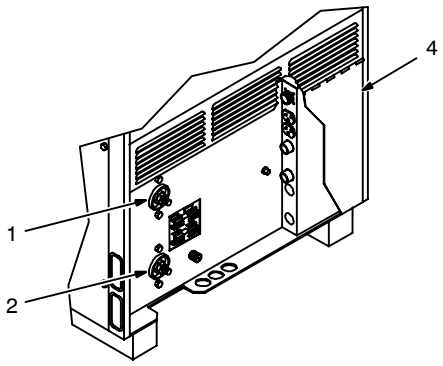
Location of Terminals



Tools Needed:

3/4 in

1 Work Weld Output Terminal

2 Electrode Weld Output Terminal

3 Torch Cable Adapter

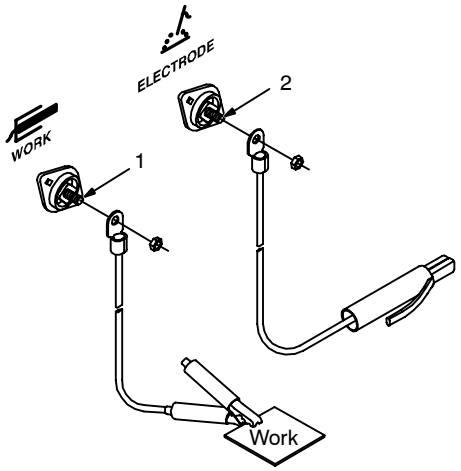
Adapter connects power and water to torch and cooling system or drain.

4 Access Door

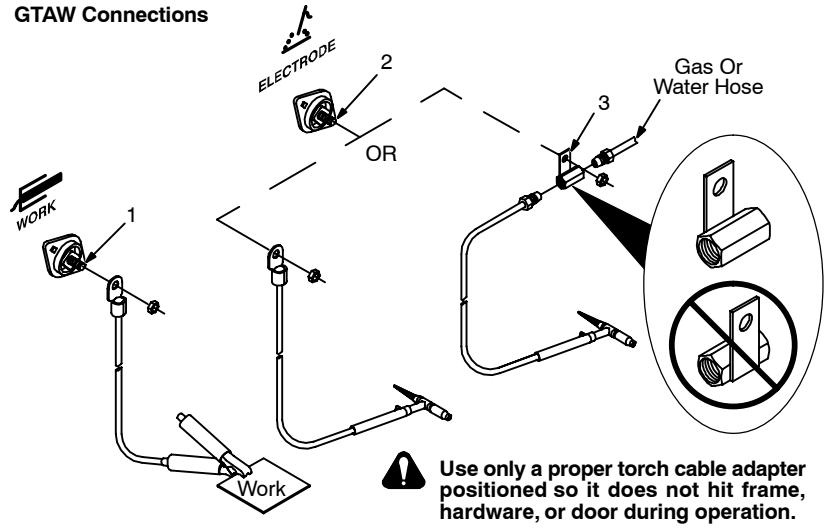
Connect cables as shown.

Close and secure access door.

SMAW Connections



GTAW Connections



⚠ Use only a proper torch cable adapter positioned so it does not hit frame, hardware, or door during operation.

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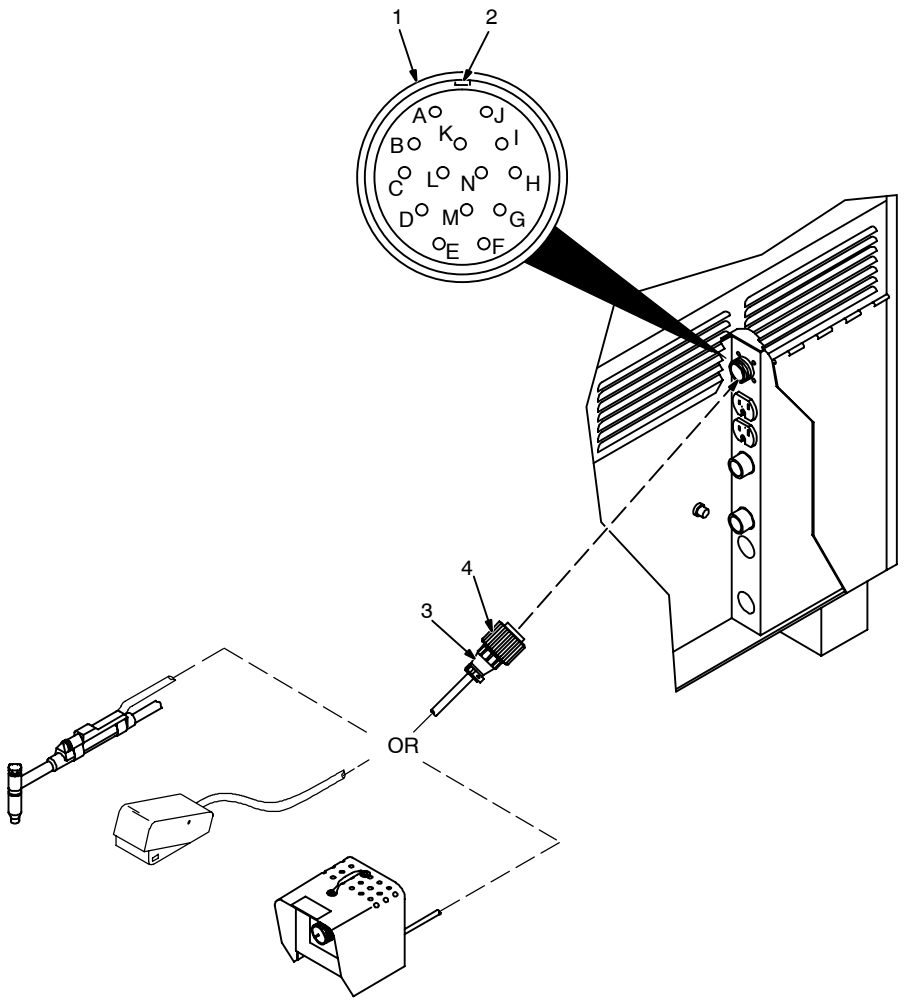
Figure 3-8. Weld Output Connections

3-8. Remote 14 Receptacle Information And Connections



1 Remote 14 Receptacle RC2 (See Table 3-2)

2 Keyway

3 Plug

4 Threaded Collar

To connect to receptacle, align keyway, insert plug, and tighten threaded collar.

sb7.1 5/94 – Ref. ST-144 405-B / Ref. S-0004-A / S-0750

Figure 3-9. Remote 14 Connections

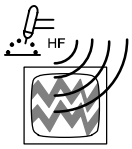
Table 3-2. Remote 14 Socket Information

REMOTE 14	Socket*	Socket Information
OUTPUT (CONTACTOR)	A	24 volts ac.
	B	Contact closure to A completes 24 volts ac contactor control circuit.
A/V AMPERAGE VOLTAGE	C	+10 volts dc output to remote control.
	D	Remote control circuit common.
	E	0 to +10 volts dc input command signal from remote control.

*The remaining sockets are not used.

3-9. Connecting Input Power

⚠ WARNING



HIGH-FREQUENCY RADIATION can interfere with radio navigation, safety services, computers, and communications equipment.

- Have only qualified person familiar with electronic equipment perform this installation.
- Read and follow entire Section 7 for proper location and installation requirements for high-frequency equipment before installing unit.

ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn Off welding power source, and disconnect input power before inspecting or installing.
- Have only qualified persons install unit.
- Installation must meet National Electrical Code and all other codes.

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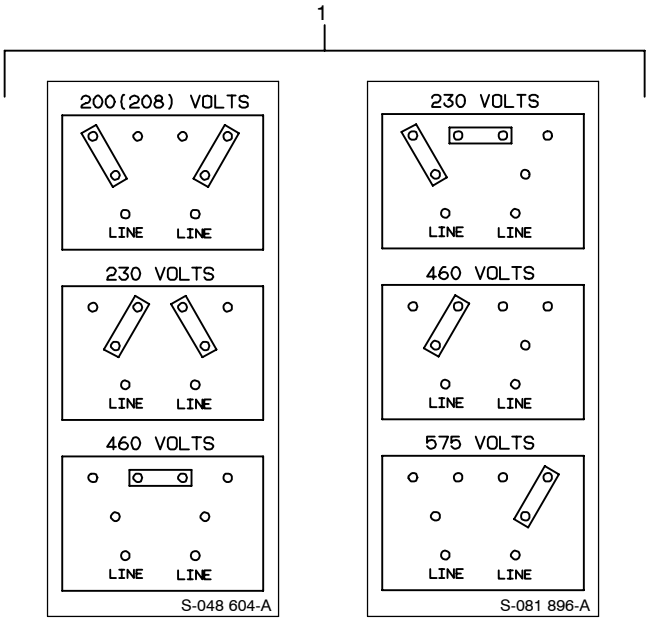
A. Positioning Jumper Links



Jumper links allow operation on different input voltages and are factory set for the highest input voltage.

Check input voltage available at site.

Remove side panel to check jumper links.

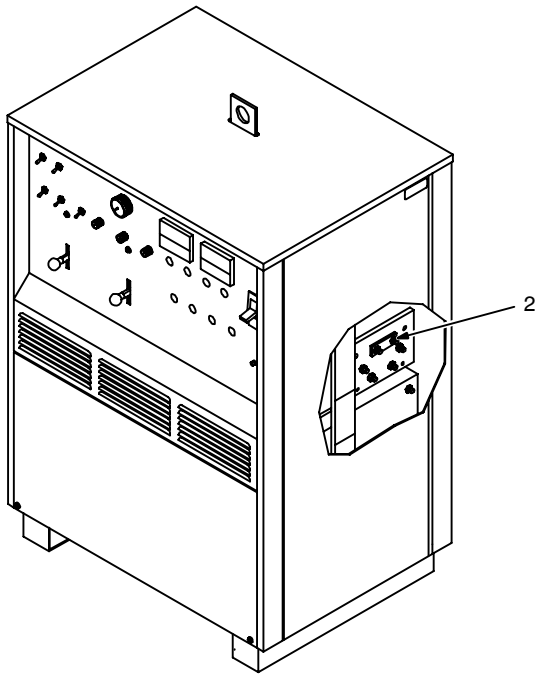
1 Input Voltage Label – Only One Is On Unit

Look at jumper links and compare link position with unit label.

2 Input Voltage Jumper Links

Move links to match input voltage. For example, use 230 volts position when 230 volts input power is available.

Reinstall side panel or go on to Figure 3-11.



Tools Needed:

1/2 in

3/8 in

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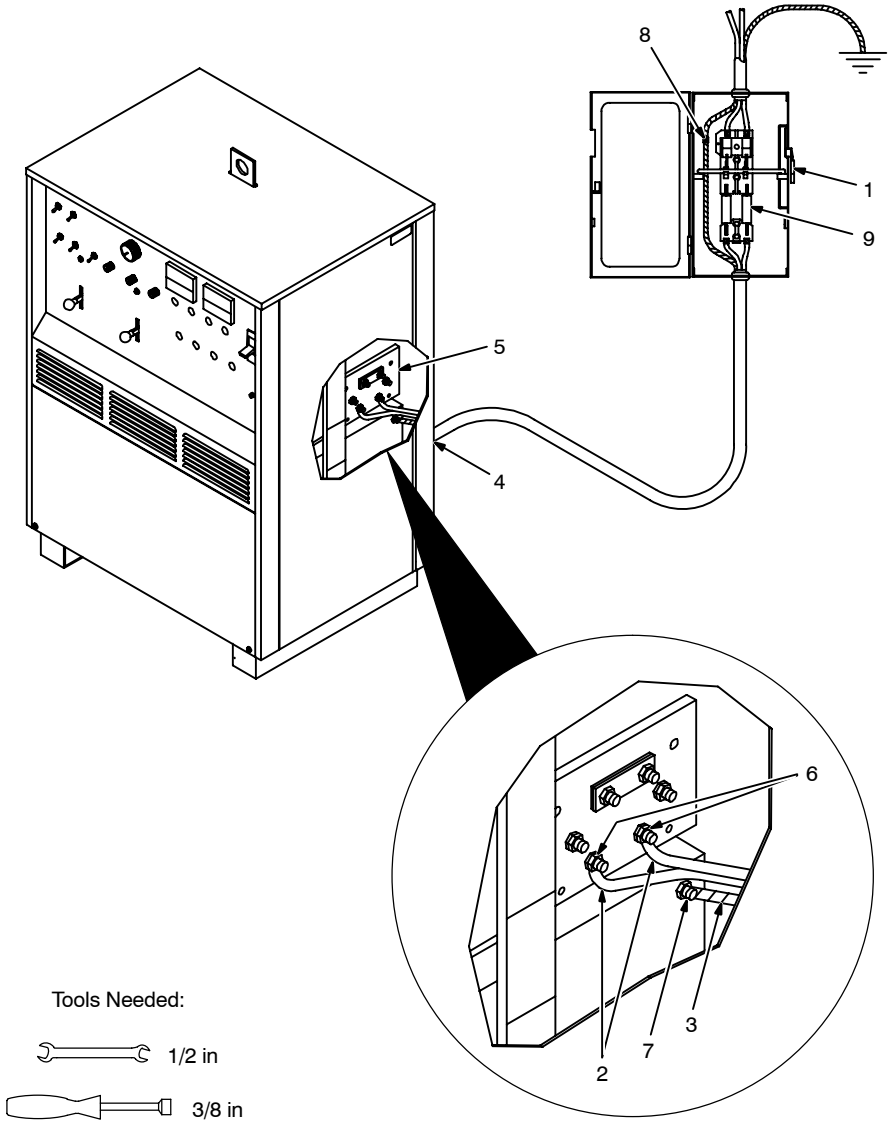
Figure 3-10. Input Voltage Jumper Links Location

B. Connecting Input Power



Have only qualified persons make this installation.

Remove side panel.

1 Line Disconnect Device Of Proper Rating

2 Input Conductors

3 Grounding Conductor

Select size and length using Table 3-3. Conductor rating must comply with national, state, and local electrical codes. Use lugs of proper amperage capacity and correct hole size.

4 Strain Relief Connector

Insert conductors through strain relief.

5 Input Terminal Board

6 Line Terminals

7 Welding Power Source Ground Terminal

Connect grounding conductor to ground terminal first. Then connect input conductors to line terminals.

8 Disconnect Device Ground Terminal

Install and connect grounding conductor and input conductors in conduit or equivalent to deenergized line disconnect device.

Connect grounding conductor first, then line input conductors.

Be sure grounding conductor goes to an earth ground.

Reinstall side panel.

9 Overcurrent Protection

Select type and size using Table 3-3. Install into deenergized line disconnect device (fused disconnect switch shown).

ssb2.4 1/94 – SB-127 873-B

Figure 3-11. Input Power Connections

Table 3-3. Electrical Service Requirements*

Input Voltage	200	230	460	575
Input Amperes At Rated Output	206	180	90	72
Recommended Standard Fuse Or Circuit Breaker Rating In Amperes[1]	300	250	125	110
Input Conductor Size In AWG/Kcmil[2]	2/0	1/0	4	6
Max Input Conductor Length In Feet (Meters)[3]	139 (42)	163 (50)	318 (97)	336 (102)
Grounding Conductor Size In AWG/Kcmil[4]	4	4	6	6

* These values are calculated from the 1993 edition of the National Electrical Code (NEC).

1 Recommended fuse or circuit breaker size is that closest to 150% of rated input amperage of the welding power source. Article 630-12(a) of NEC allows fuse or circuit breaker sizing up to 200% of rated input amperage.

2 Input conductor size is for insulated copper wire with 75°C rating with not more than three single current-carrying conductors in a cable or raceway (Table 310-16 of NEC).

3 Maximum length is to prevent more than a 3% voltage drop between service entrance and input terminals of the welding power source (Articles 210-19(a) and 215-2(b) of NEC).

4 The grounding conductor shall be colored or identified as specified in the NEC. Grounding conductor size for copper wire is not required to be larger than input conductor (Article 250-95 of NEC).

S-0092-G

⚠ WARNING

ELECTRIC SHOCK can kill.

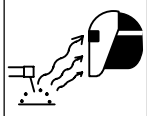
- Always wear dry insulating gloves.
- Insulate yourself from work and ground.
- Do not touch live electrical parts.
- Keep all panels and covers securely in place.

FUMES AND GASES can be hazardous to your health.

- Keep your head out of the fumes.
- Ventilate area, or use breathing device.
- Read Material Safety Data Sheets (MSDSs) and manufacturer's instructions for material used.

WELDING can cause fire or explosion.

- Do not weld near flammable material.
- Watch for fire; keep extinguisher nearby.
- Do not locate unit over combustible surfaces.
- Do not weld on closed containers.
- Allow work and equipment to cool before handling.

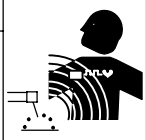


ARC RAYS can burn eyes and skin; NOISE can damage hearing.

- Wear welding helmet with correct shade of filter.
- Wear correct eye, ear, and body protection.

MOVING PARTS can cause injury.

- Keep away from moving parts.
- Keep all doors, panels, covers, and guards closed and securely in place.



MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.

- Pacemaker wearers keep away.
- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.

See Safety Precautions at beginning of manual for basic welding safety information.

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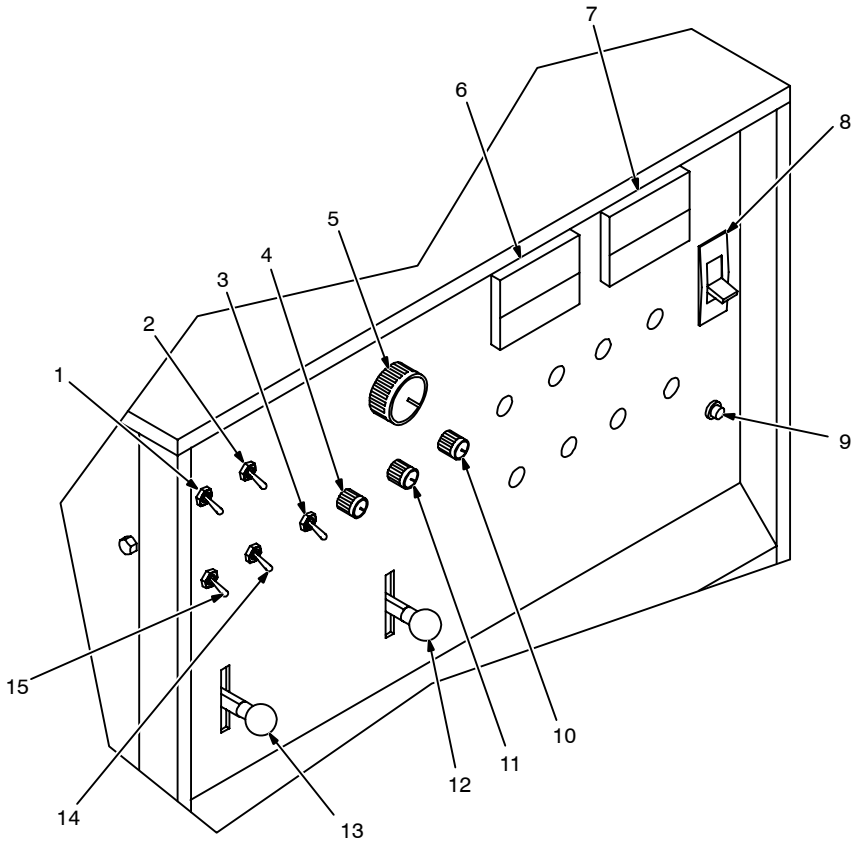
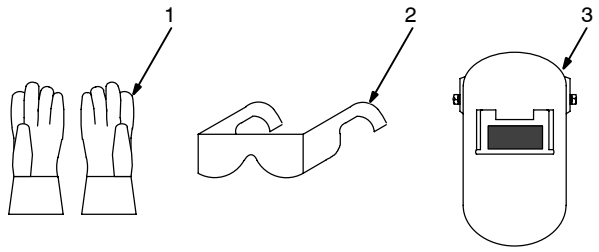


1 Output (Contactor) Switch
2 Amperage Control Switch
3 Start Amperage Switch
4 Start Amperage Control
5 Amperage Adjustment Control
6 Voltmeter
7 Ammeter
8 Power Switch
9 Pilot Light
10 Postflow Time Control
11 AC Balance Control
12 Polarity Switch
13 AC/DC Switch
14 Crater Fill Switch
15 High Frequency Switch

Ref. ST-144 405-B

Figure 4-1. Controls



Wear the following while welding:

1 Dry, Insulating Gloves

2 Safety Glasses With Side Shields

3 Welding Helmet With Correct Shade Of Filter (See ANSI Z49.1)

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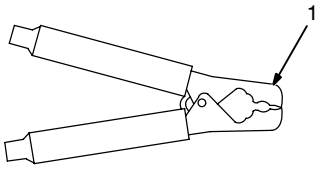
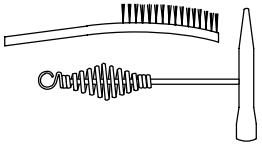
Figure 4-2. Safety Equipment



Tools Needed:



1 Work Clamp

Connect work clamp to a clean, paint-free location on workpiece, as close to weld area as possible.

Use wire brush or sandpaper to clean metal at weld joint area. Use chipping hammer to remove slag after welding.

sb4.1 2/93

Figure 4-3. Work Clamp

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not use AC output in damp areas, if movement is confined, or if there is a danger of falling.
- Use AC output ONLY if required for the welding process.
- If AC output is required, use remote output control.
- Read Safety Precautions at beginning of this manual.

ARCING can damage switch.

- Do not change AC/DC or Polarity switch position while welding.

Arcing inside switch can damage contacts, causing switch to fail.

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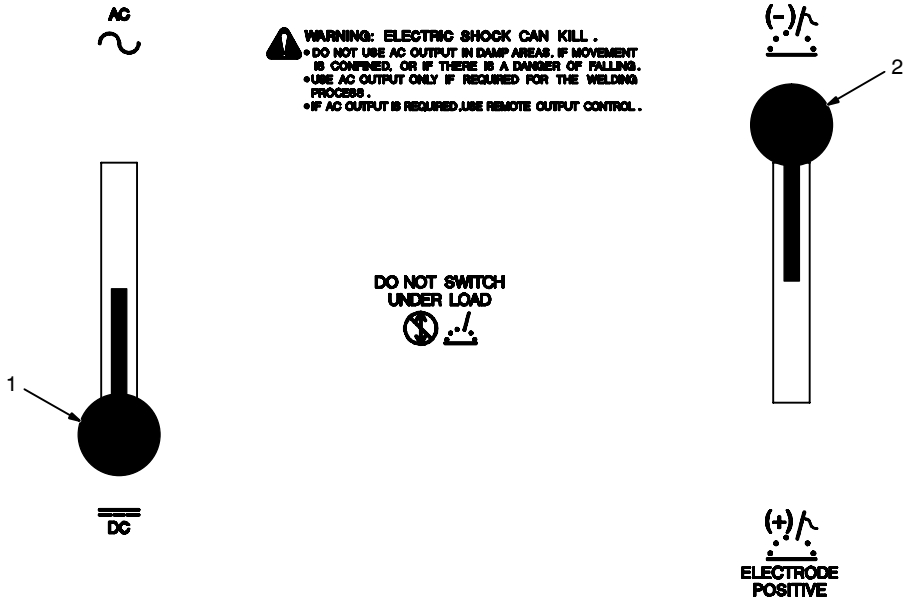

AC
WARNING: ELECTRIC SHOCK CAN KILL.
• DO NOT USE AC OUTPUT IN DAMP AREAS, IF MOVEMENT IS CONFINED, OR IF THERE IS A DANGER OF FALLING.
• USE AC OUTPUT ONLY IF REQUIRED FOR THE WELDING PROCESS.
• IF AC OUTPUT IS REQUIRED, USE REMOTE OUTPUT CONTROL.
ELECTRODE NEGATIVE
(-)
2
1
DO NOT SWITCH UNDER LOAD
DC
(+)
ELECTRODE POSITIVE

1 AC/DC Switch

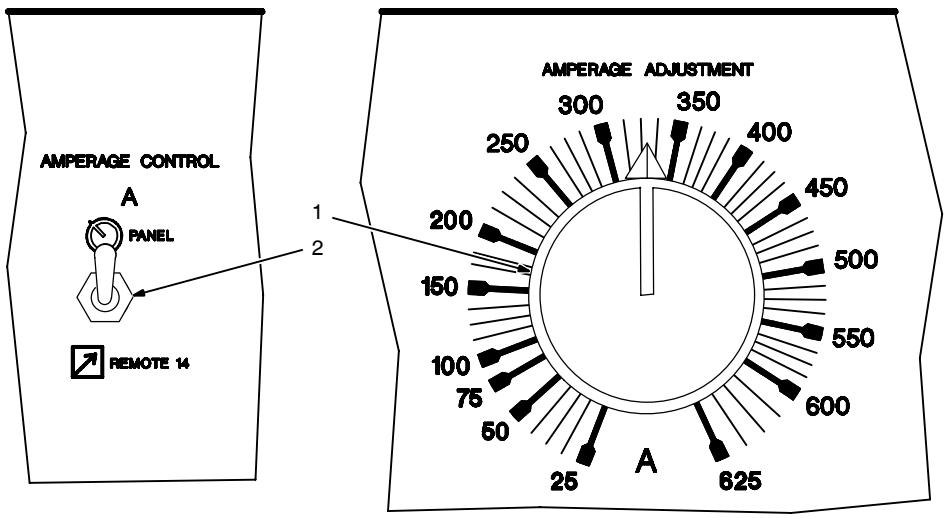
Use switch to select type of weld output.

2 Polarity Switch

Use switch to select either DC Electrode Positive (DCEP) or DC Electrode Negative (DCEN) output.

Ref. ST-116 740-A

Figure 4-4. AC/DC And Polarity Switches



1 Amperage Adjustment Control

Use control to select weld output amperage.

2 Amperage Control Switch

Use switch to select way of controlling amperage adjustment.

For front panel control, place switch in the Panel position.

For remote control, place switch in Remote 14 position (see Section 3-8).

3 Fingertip Control

4 Remote Hand Control

5 Remote Foot Control

See example below.

Example Of Front Panel Amperage Control

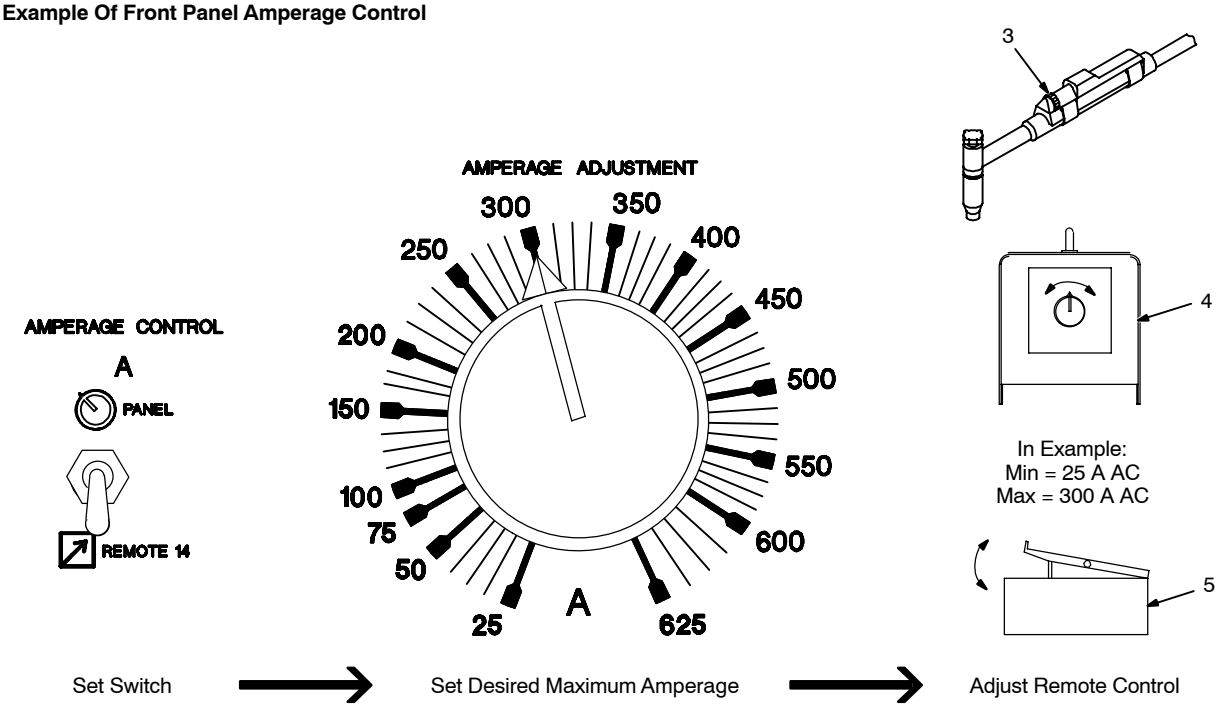
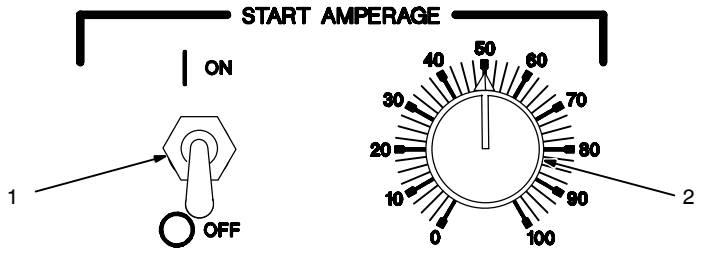


Figure 4-5. Amperage/Voltage Controls



1 Start Switch

On – provides start amperage control;
Off – no start amperage control.

2 Start Amperage Control

Use control to select amperage level for arc starting that is different than Amperage Adjustment control setting.

The numbers are a percentage of the maximum welding amperage of the unit and not an actual value.

Figure 4-6. Start Amperage Controls

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Do not touch weld output terminals when contactor is energized.
- Do not touch electrode and work clamp at the same time.

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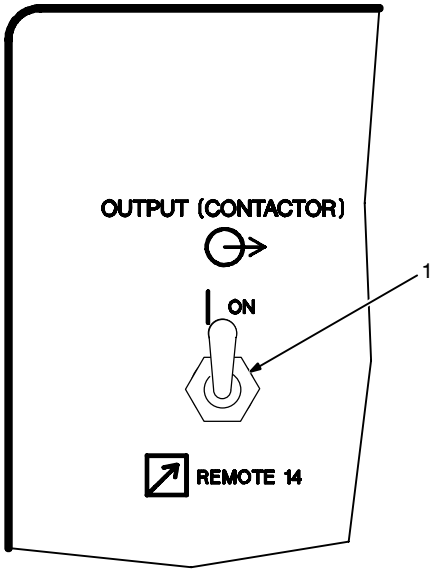
⚠ **Weld output terminals are energized when switch is On and Power is On.**



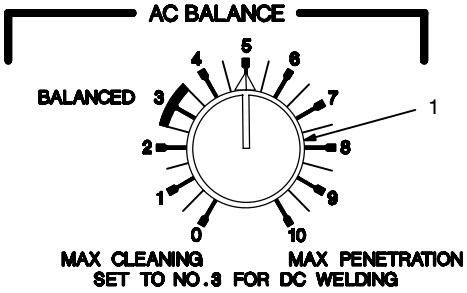
1 Output (Contactor) Switch

Use switch to select way of controlling unit output.

For weld output, place switch in On position.

For remote output control, place switch in Remote 14 position (see Section 3-8).

Figure 4-7. Output (Contactor) Switch

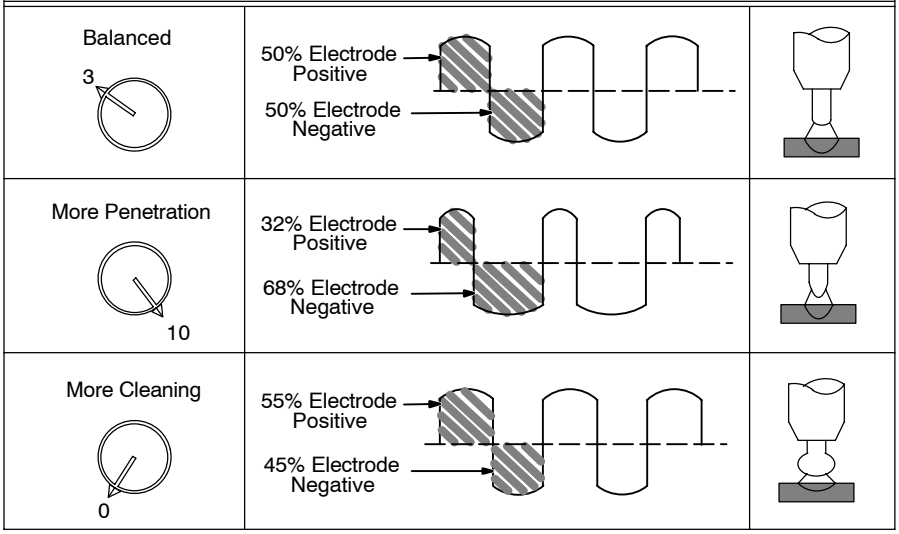


1 AC Balance Control

Use control to change the ac output square wave.

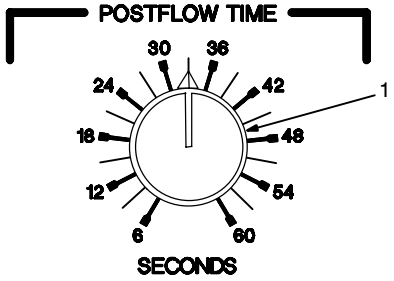
Turn control towards 10 to obtain deeper penetration. Turn control towards 0 to obtain more cleaning action of the workpiece. The wave shape of position 3 (balanced), provides equal penetration and cleaning action, and is a recommended starting point for GTAW.

Balance Control Waveform Examples



S-0795-A

Figure 4-8. AC Balance Control



1 Postflow Time Control

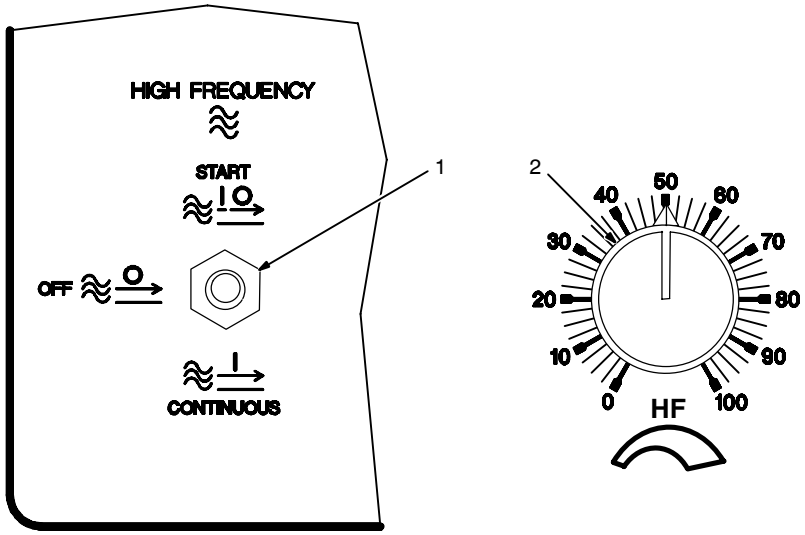
Use control to set the length of time in seconds gas (and coolant if applicable) flows after welding stops.

Figure 4-9. Postflow Time Control

⚠ WARNING

USING HIGH FREQUENCY WITH THE SHIELDED METAL ARC WELDING (SMAW) PROCESS can result in serious personal injury.

- Place the High Frequency switch in the Off position before using the Shielded Metal Arc Welding (SMAW) Process.



1 High Frequency Switch

Off – No HF. Use Off for SMAW welding.

Start – provides HF for arc starting only.

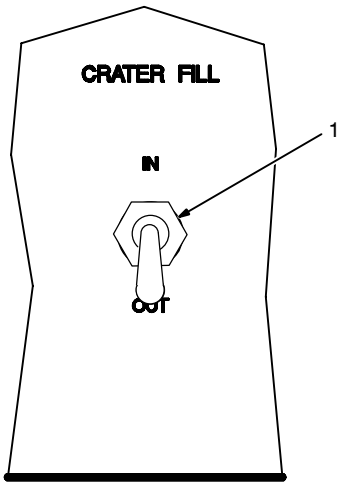
Continuous – provides HF continuously throughout the weld.

2 High Frequency Intensity Control (Figure 3-5)

Use control to change amount of HF energy used to start and maintain the arc. Set as low as practical to prevent interfering with electronic equipment. Numbers around the control are for reference only.

S-000 485

Figure 4-10. High Frequency Controls



1 Crater Fill Switch

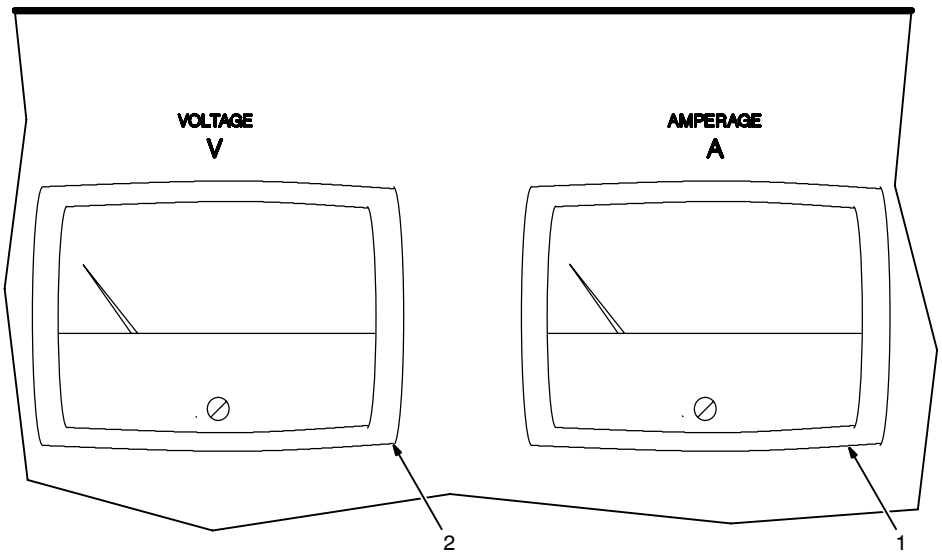
In – provides crater time;
Out – provides no crater time.

Place switch in the Out position for SMAW.

Use crater to taper weld output from setting of the Amperage Adjustment control to the minimum of the unit.

When using the crater time circuit, set Postflow Time Control (see Figure 4-9) for at least 8 to 10 seconds.

Figure 4-11. Crater Fill Switch



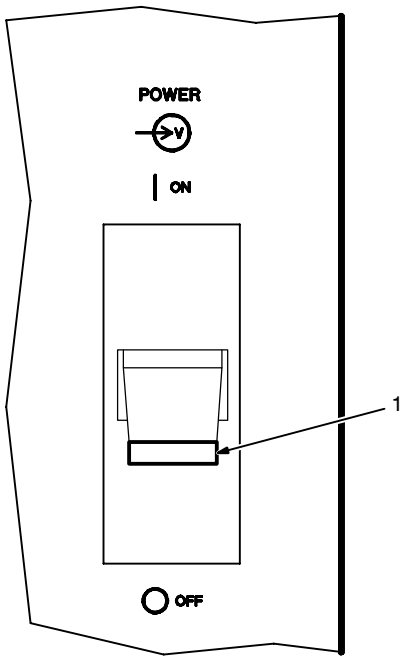
1 Ammeter

Ammeter displays weld amperage output of unit.

2 Voltmeter

Voltmeter displays voltage at the weld output terminals, but not necessarily the welding arc due to cable resistance, poor connections, etc.

Figure 4-12. Ammeter And Voltmeter



1 Power Switch

Use this switch to turn unit and pilot light On and Off.

Figure 4-13. Power Switch

⚠ WARNING

BUILDUP OF SHIELDING GAS can harm health or kill.

- Shut off shielding gas supply when not in use.

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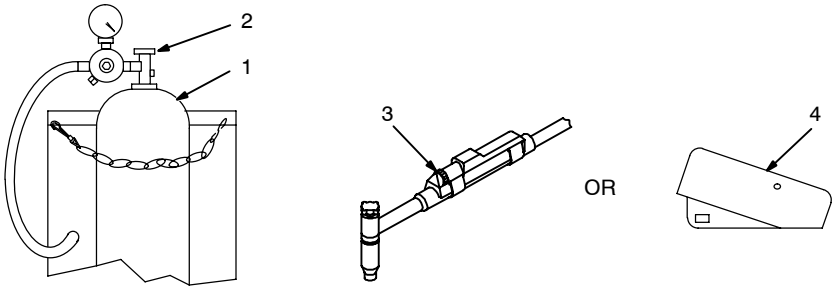

1 Shielding Gas Cylinder
2 Valve
3 Fingertip Control
4 Foot Control

Open valve on cylinder just before welding.

Fingertip control or foot control turns weld output and gas flow on and off.

Close valve on cylinder when finished welding.

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Figure 4-14. Shielding Gas

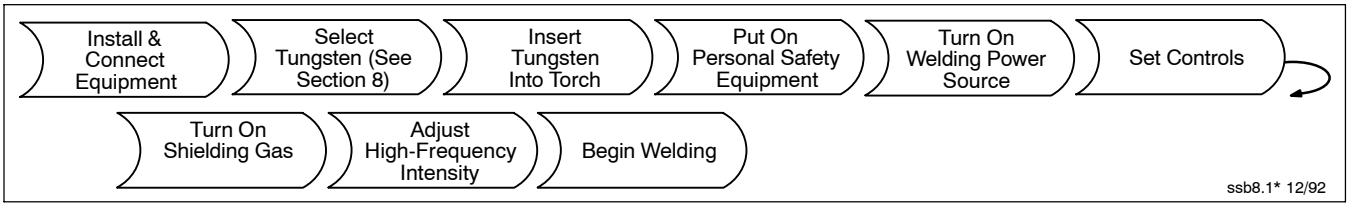

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Figure 4-15. Sequence Of Gas Tungsten Arc Welding (GTAW)

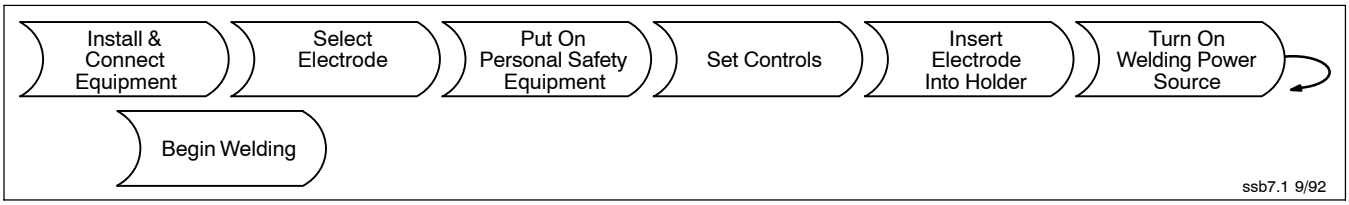

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Figure 4-16. Sequence Of Shielded Metal Arc Welding (SMAW)

SECTION 5 – MAINTENANCE & TROUBLESHOOTING

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn Off welding power source, and disconnect input power before inspecting, maintaining, or servicing.

HOT PARTS can cause severe burns.

- Allow cooling period before maintaining or servicing.

MOVING PARTS can cause injury.

- Keep away from moving parts.

Maintenance to be performed only by qualified persons.

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5-1. Routine Maintenance

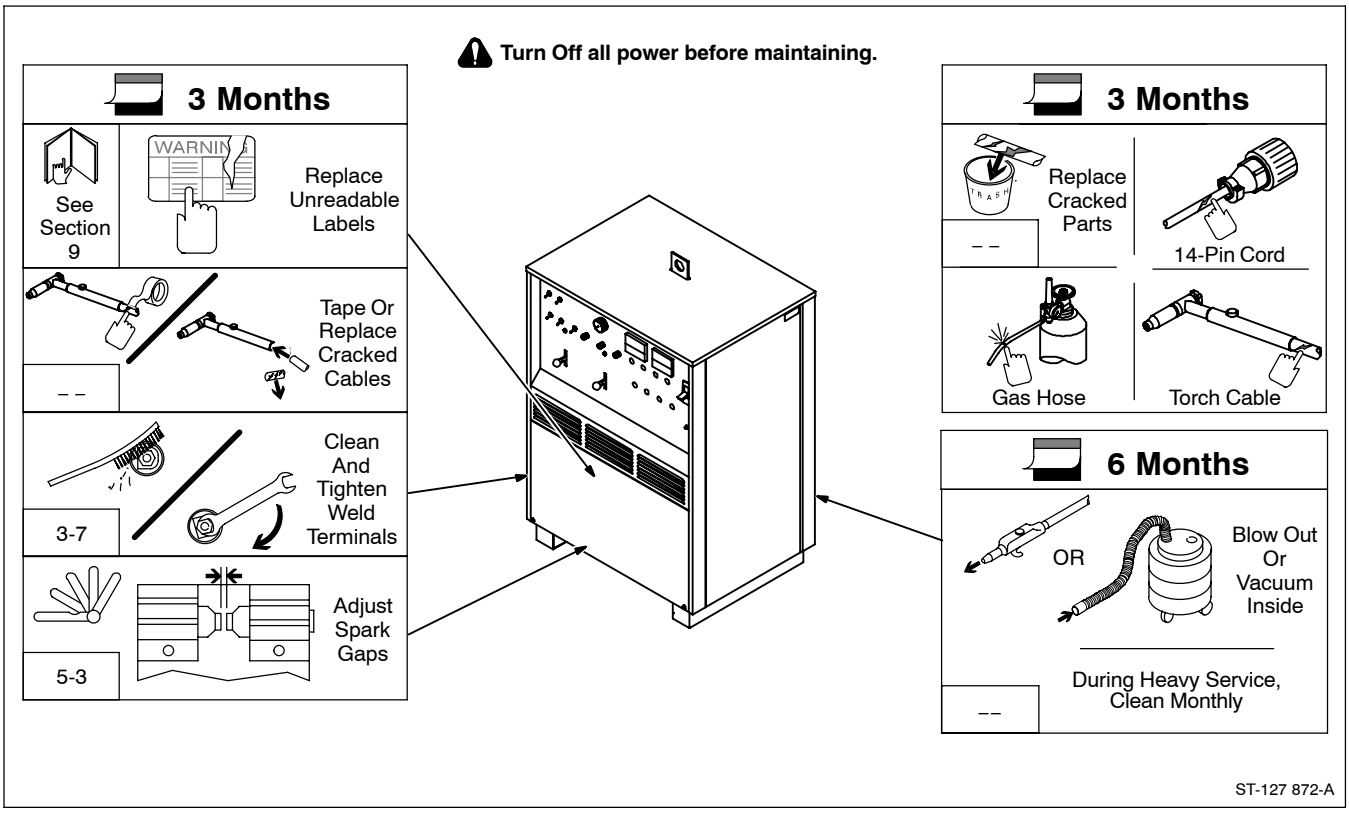
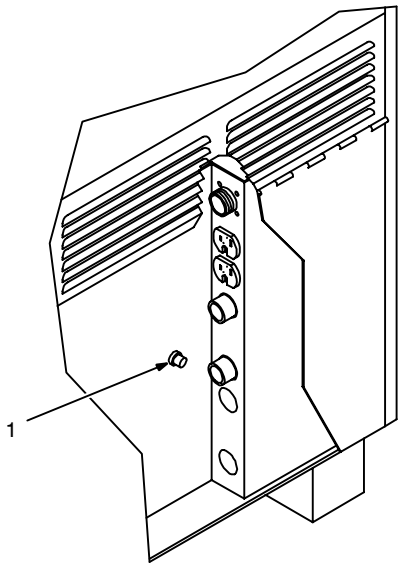


Figure 5-1. Maintenance Schedule

5-2. Overload Protection

WARNING **READ SAFETY BLOCKS at start of Section 5 before proceeding.**



1 Circuit Breaker CB1

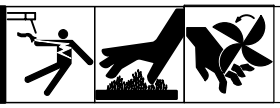
CB1 protects the 115 volts ac winding of transformer T1 from overload. If CB1 opens, high frequency and output to the 115 volts ac duplex receptacle stop.

Press button to reset breaker. Close access door.

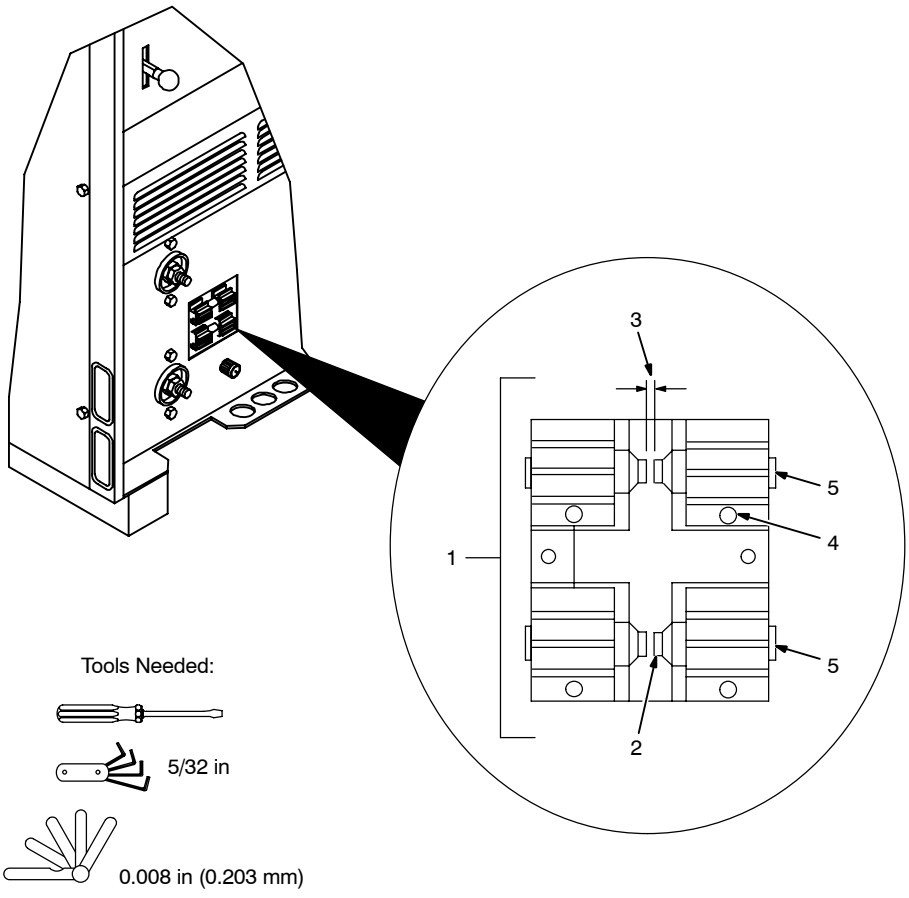
Figure 5-2. Circuit Breaker CB1

5-3. Adjusting Spark Gaps

⚠ WARNING



READ SAFETY BLOCKS at start of Section 5 before proceeding.



Tools Needed:

5/32 in

0.008 in (0.203 mm)

Turn Off welding power source and disconnect input power.

1 Spark Gap Assembly

Remove cover plate.

2 Tungsten End Of Point

Do not clean or dress tungsten. Replace point if tungsten end disappears.

3 Spark Gap

Normal spark gap is 0.008 in (0.203 mm).

If spark gap is okay, reinstall cover plate and close access door. If adjustment is needed, continue as follows:

4 Adjustment Screws

Loosen screws. Place feeler gauge of proper thickness in spark gap.

5 Pressure Point

Apply slight pressure at point until gauge is held firmly in gap. Tighten adjustment screws. Repeat gauge adjustment with other gap.

Reinstall cover plate and close access door.

S-0043 / Ref. ST-144 405-B

Figure 5-3. Adjusting Spark Gaps

5-4. Troubleshooting

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn Off welding power source, and disconnect input power before inspecting, maintaining, or servicing.

HOT PARTS can cause severe burns.

- Allow cooling period before servicing.

MOVING PARTS can cause injury.

- Keep away from moving parts.

Troubleshooting to be performed only by qualified persons.

swarn9.1 2/93

Table 5-1. Welding Trouble

Trouble	Remedy	Section
No weld output; unit completely inoperative.	Place Power switch in On position.	Figure 4-13
	Place line disconnect switch in the On position.	3-9
	Check and replace line fuse(s) or reset circuit breakers.	3-9
	Check for proper input connections.	3-9
	Check for proper jumper link positions.	3-9
No weld output; fan on.	Place Output (Contactor) switch in On position, or place switch in Remote 14 position and connect remote contactor to Remote 14 receptacle.	3-8, Figure 4-7
	Check, repair, or replace remote control.	– –
	Have Factory Authorized Service Station/Service Distributor check control board PC1.	– –
Unit provides only maximum or minimum weld output.	Have Factory Authorized Service Station/Service Distributor check control board PC1, and hall device HD1.	– –
Weld output always above or always below set value.	Have Factory Authorized Service Station/Service Distributor check control board PC1, and hall device HD1.	– –
Erratic or improper weld output.	Use proper size and type of weld cable.	3-3
	Clean and tighten all weld connections.	3-3, 3-7
	Be sure AC/DC switch and Polarity switch are in proper position for welding process.	Figure 4-4
	Have Factory Authorized Service Station/Service Distributor check control board PC1, and hall device HD1.	– –
No AC Balance Control.	Have Factory Authorized Service Station/Service Distributor check and replace AC Balance Control, if necessary, and check control board PC1.	Figure 4-8

Trouble	Remedy	Section
No control of weld output.	Place Amperage Control switch in Panel position, or place switch in Remote 14 position and connect remote control to Remote 14 receptacle.	3-8, Figure 4-5
	Have Factory Authorized Service Station/Service Distributor replace Amperage Adjustment control or check control board PC1.	Figure 4-5
No output from duplex receptacle RC1, no gas flow, and no high frequency.	Check, and reset circuit breaker CB1 if necessary.	5-2
No high frequency; difficulty in establishing GTAW arc.	Check, and reset circuit breaker CB1 if necessary.	5-2
	Select proper size tungsten.	8-1
	Check High Frequency Intensity control setting.	Figure 4-10
	Be sure that electrode holder cable is not close to any grounded metal.	– –
	Check cables and torch for cracked insulation or bad connections. Repair or replace necessary parts.	– –
	Check spark gaps and adjust if necessary.	5-3
Wandering arc – poor control of direction of arc.	Reduce gas flow rate.	3-5
	Select proper size tungsten.	8-1
	Properly prepare tungsten.	8-2
Tungsten electrode oxidizing and not remaining bright after conclusion of weld.	Shield weld zone from drafts.	– –
	Increase postflow time.	Figure 4-9
	Check and tighten all gas fittings.	3-5
	Properly prepare tungsten.	8-2
	Replace torch parts if water has leaked into torch.	– –

NOTES

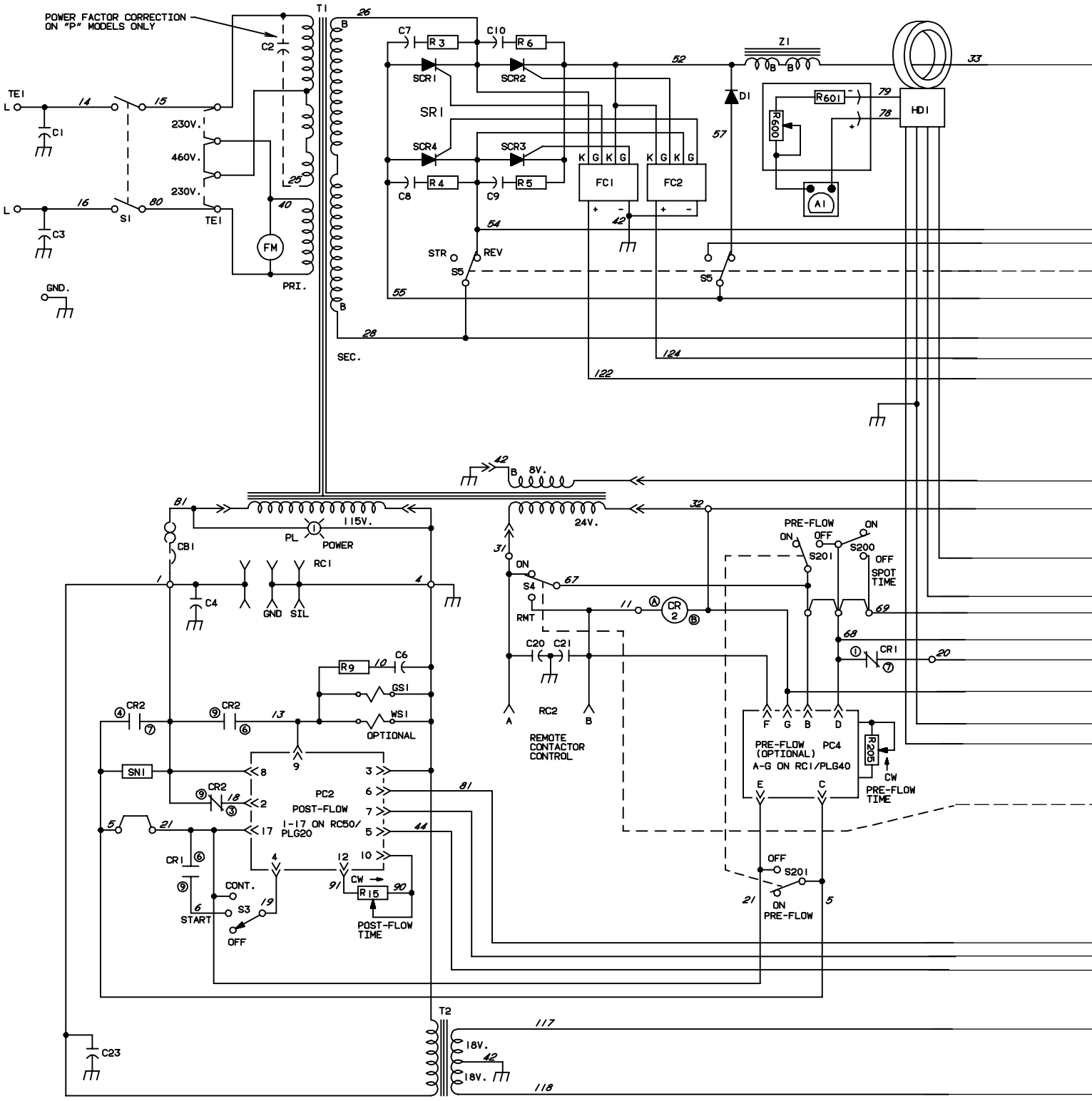
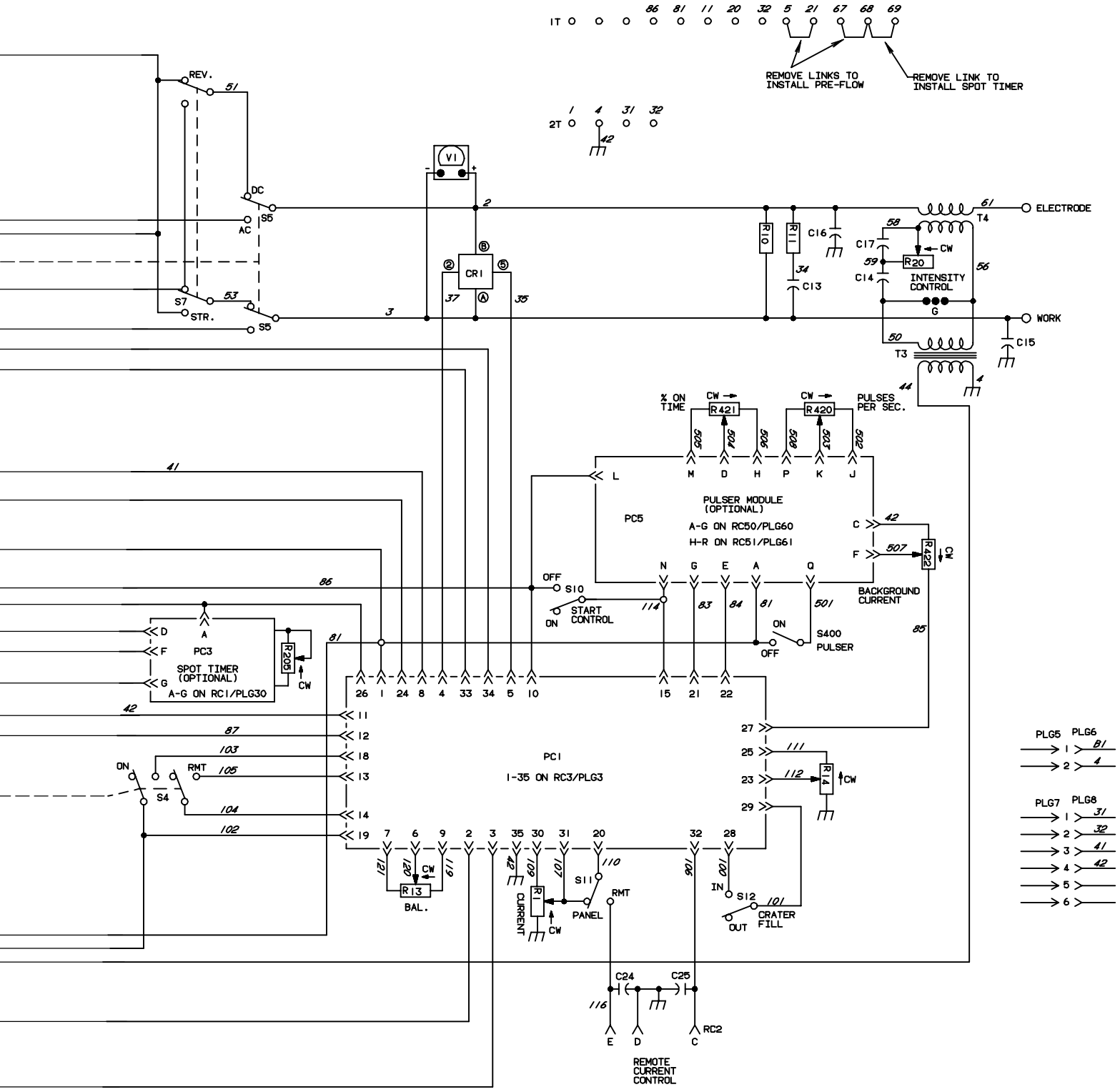


Figure 6-1. Circuit Diagram For Welding Power Source


1T
86 81 11 20 32 5 21 67 68 69
REMOVE LINKS TO INSTALL PRE-FLOW
REMOVE LINK TO INSTALL SPOT TIMER
2T
1 4 31 32
42
V1
REV.
51
DC
S5
AC
S7
STR.
53
3
2
CR1
37
35
R10
R11
C16
C13
34
T4
61
ELECTRODE
58
C17
59
C14
CW
R20
INTENSITY CONTROL
56
G
WORK
C15
50
T3
44
4
% ON TIME
CW
R421
PULSES PER SEC.
R420
505 504 506 508 507 502
M D H P K J
L
PULSER MODULE (OPTIONAL)
PC5
A-G ON RC50/PLG60
H-R ON RC51/PLG61
C
F
507
R422
CW
N G E A Q
BACKGROUND CURRENT
OFF
S10
START CONTROL
ON
114
83 84 81 501
ON
S400 PULSER
OFF
85
D
A
F
PC3
SPOT TIMER (OPTIONAL)
A-G ON RC1/PLG30
G
R205
CW
81
26 1 24 8 4 33 34 5 10
15 21 22
42
11
87
12
103
18
ON
RMT
105
S4
13
104
14
102
19
27
25
23
29
111
112
R14
CW
PC1
I-35 ON RC3/PLG3
7 6 9 2 3 35 30 31 20
32 28
121 120 CW 119
R13
BAL.
42
109 107
R1
CURRENT
CW
S11
110
RMT
PANEL
96
100
IN
S12
101
CRATER FILL
OUT
C24 C25
116
E D C
RC2
REMOTE CURRENT CONTROL
PLG5 PLG6
1 81
2 4
PLG7 PLG8
1 31
2 32
3 41
4 42
5
6

SD-137 500

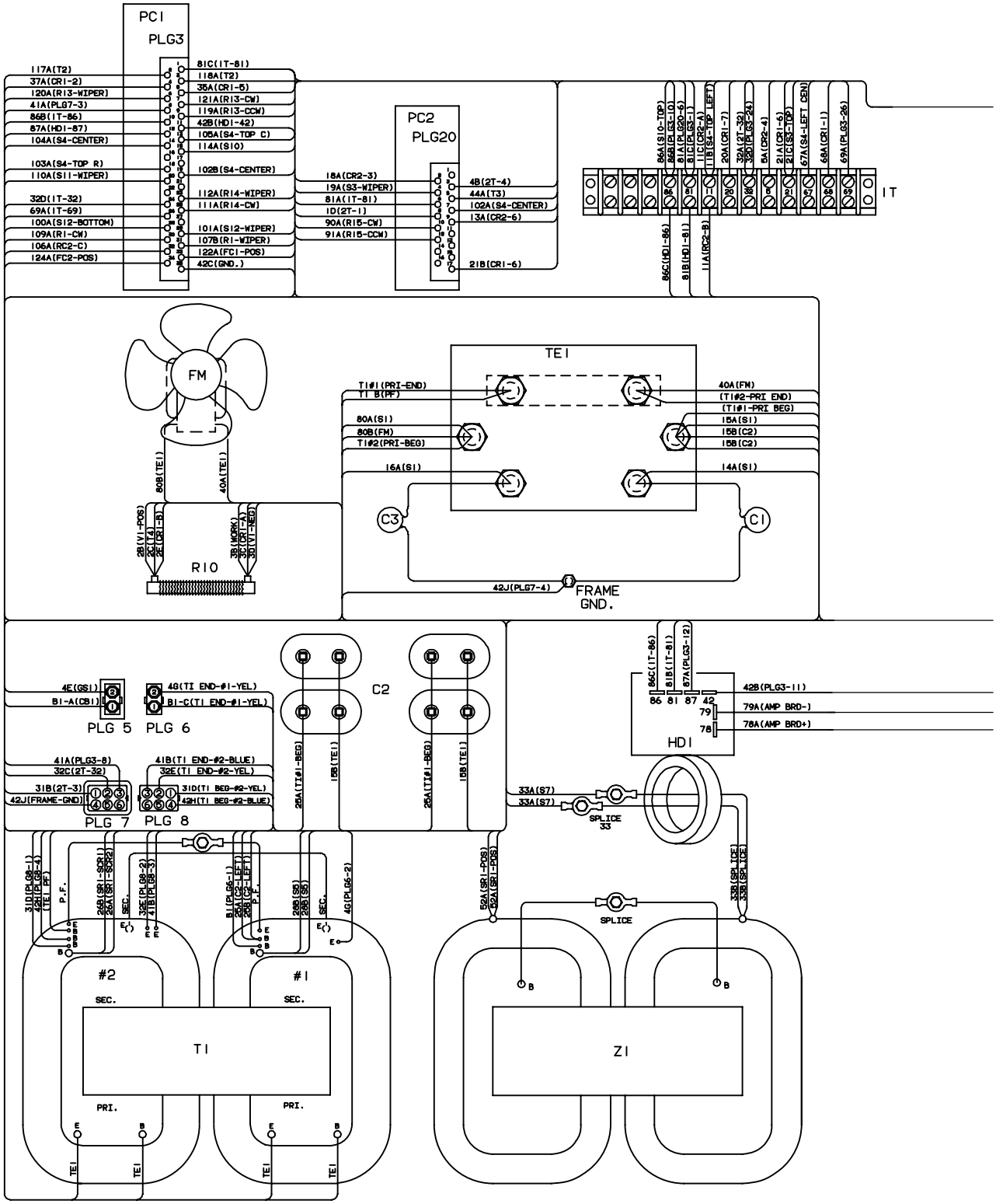
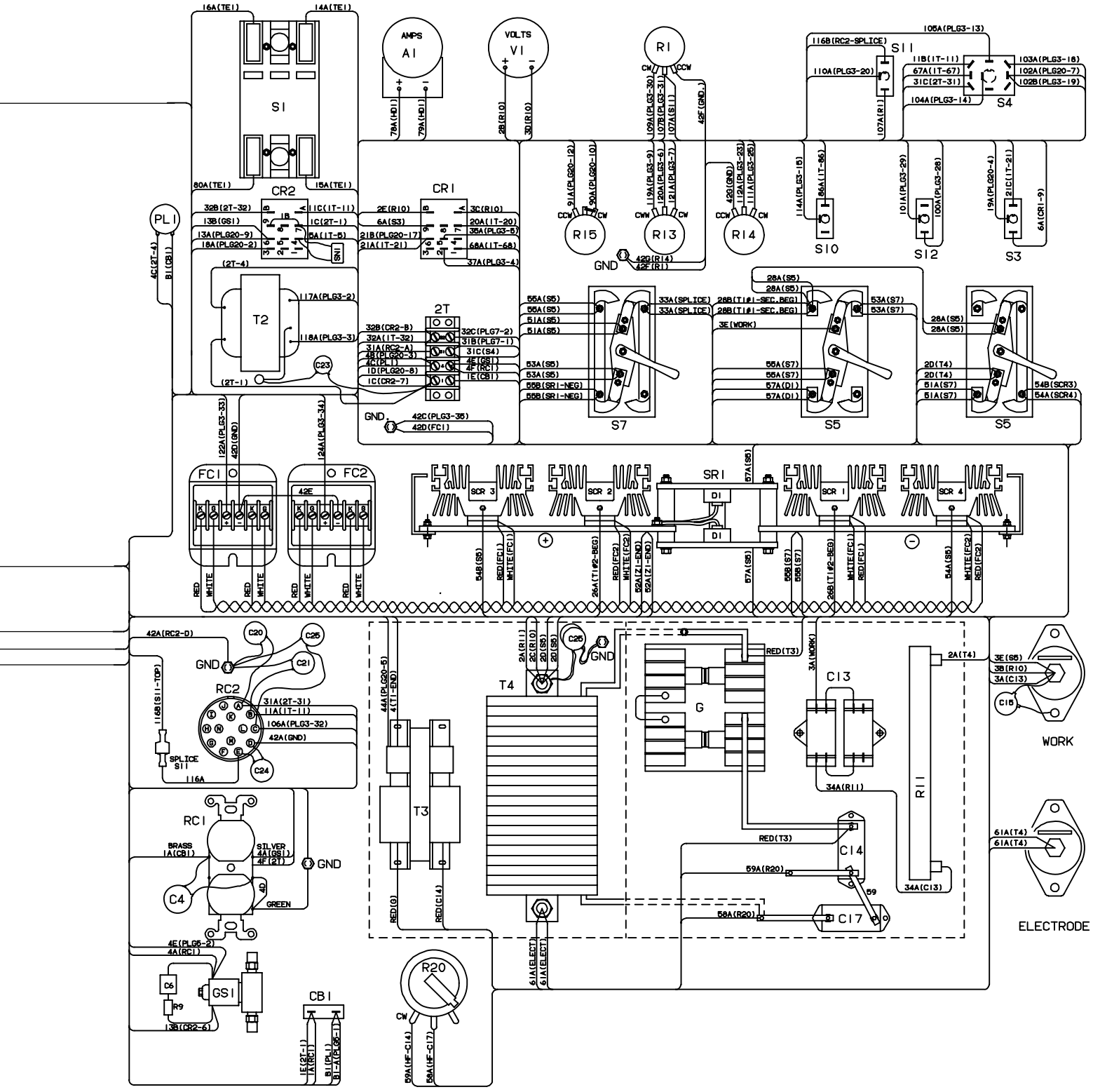
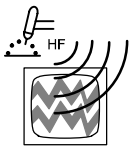


Figure 6-2. Wiring Diagram For Welding Power Source


AMPS
A1
VOLTS
V1
R1
S1
S4
S11
CR1
CR2
T2
2T
S7
S5
S10
S12
S3
R15
R13
R14
GND
FC1
FC2
SR1
SCR 1
SCR 2
SCR 3
SCR 4
T4
T3
G
C13
C14
C17
R11
RC1
RC2
GS1
CB1
R20
WORK
ELECTRODE

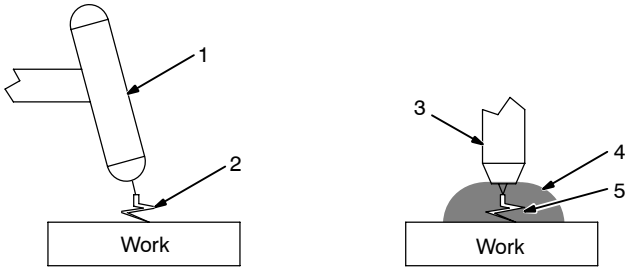
SD-139 066-A

⚠ WARNING



HIGH-FREQUENCY RADIATION can interfere with radio navigation, safety services, computers, and communications equipment.

- Have only qualified person familiar with electronic equipment perform this installation.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding as shown in Figure 7-3 to minimize the possibility of interference.



Gas Tungsten Arc Welding (GTAW)

Submerged Arc Welding (SAW)

1 Gas Tungsten Arc Torch

2 High-Frequency Voltage

Used to help arc jump air gap between torch and workpiece and/or stabilize the arc.

3 Submerged Arc Welding Gun

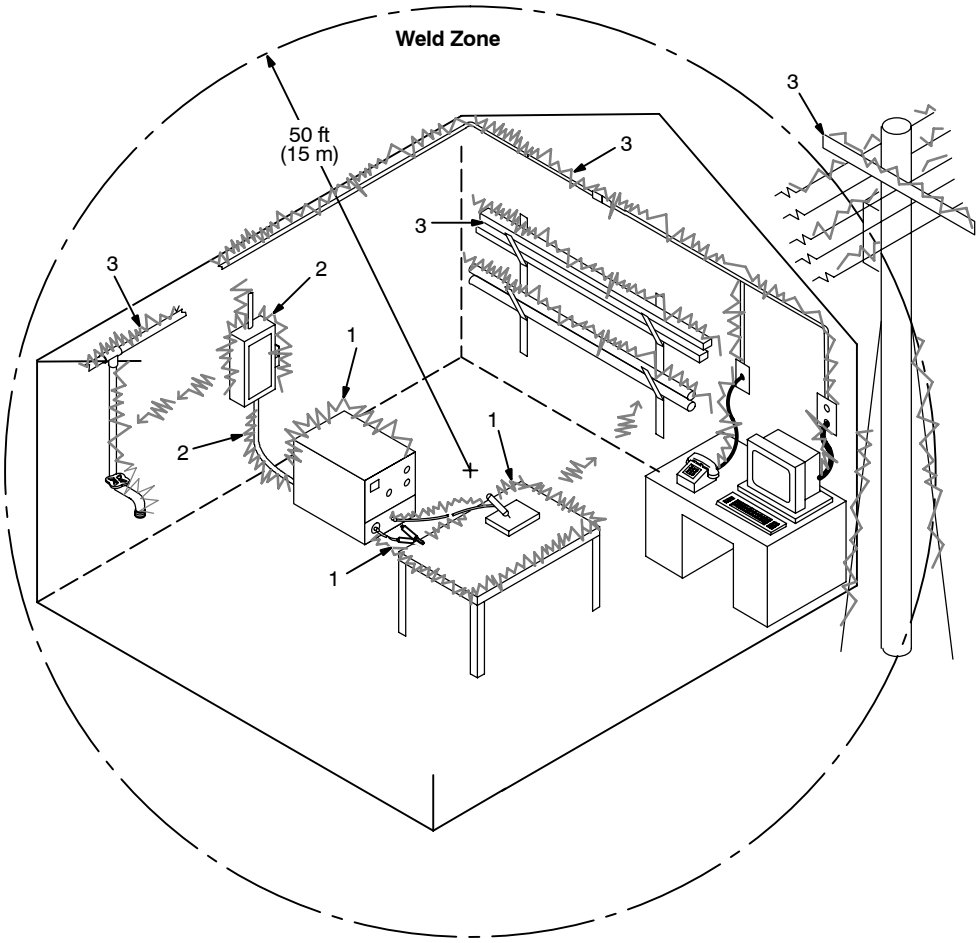
4 Flux

5 High-Frequency Voltage

Used to help arc reach workpiece through flux granules.

S-0693

Figure 7-1. Welding Processes Requiring High Frequency



1 Sources Of Direct High-Frequency Radiation

High-frequency source (welding power source with built-in HF or separate HF unit), weld cables, torch, work clamp, workpiece, and work table.

2 Sources Of Conduction Of High Frequency

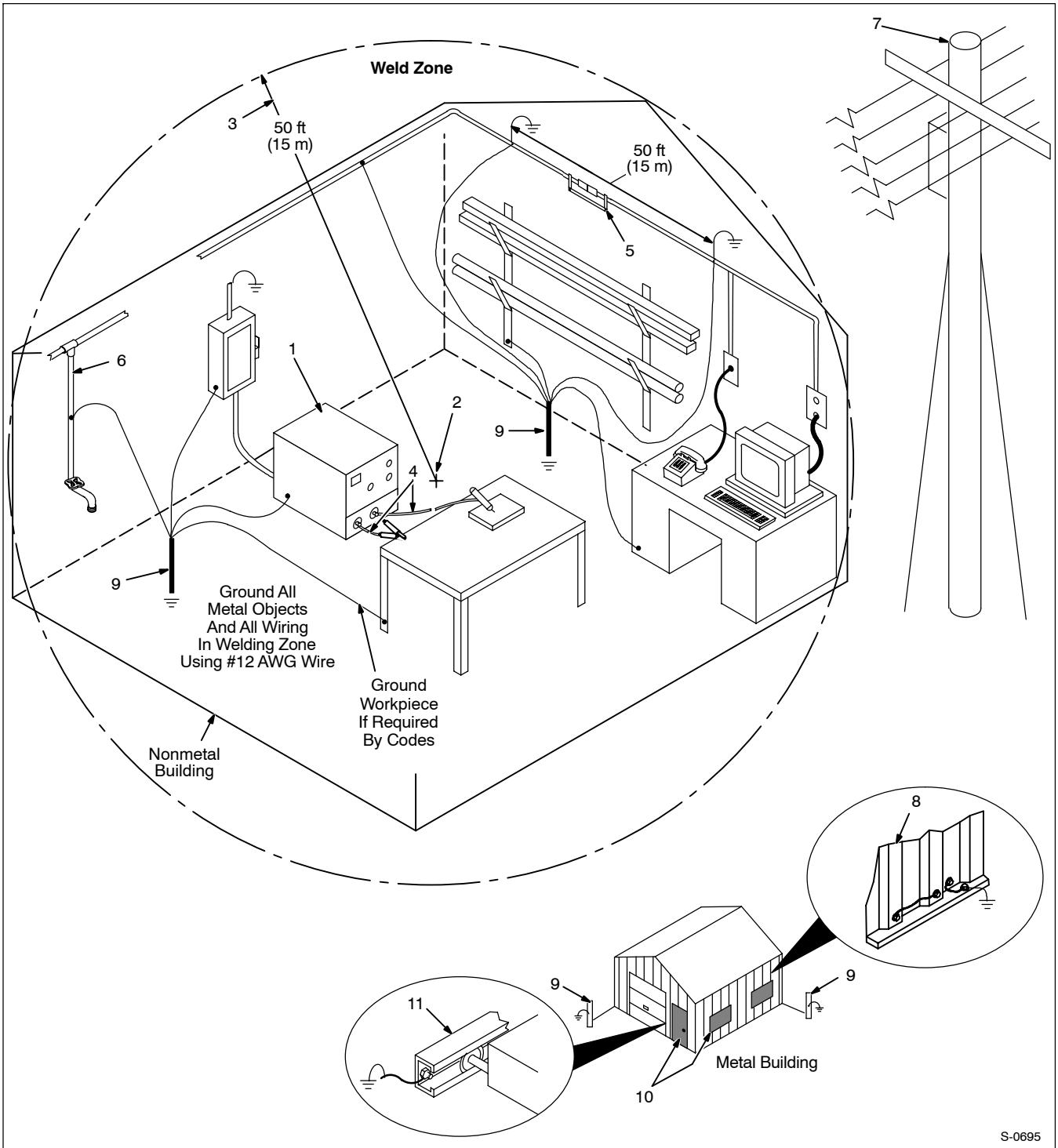
Input power cable, line disconnect device, and input supply wiring.

3 Sources Of Reradiation Of High Frequency

Ungrounded metal objects, lighting, wiring, water pipe and fixtures, external phone and power lines.

S-0694

Figure 7-2. Sources Of High-Frequency Radiation From Incorrect Installation



1 High-Frequency Source (Welder With Built-In HF Or Separate HF Unit)

Ground metal machine case, work output terminal, line disconnect device, input supply, and worktable.

2 Center Point Of Welding Zone

Midpoint between high-frequency source and welding torch.

3 Welding Zone

A circle 50 ft (15 m) from center point in all directions.

4 Weld Output Cables

Keep cables short and close together.

5 Conduit Joint Bonding

Electrically join (bond) all conduit sections using copper straps or braided wire. Ground conduit every 50 ft (15 m).

6 Water Pipe And Fixtures

Ground water pipe every 50 ft (15 m).

7 External Power Or Telephone Lines

Locate high-frequency source at least 50 ft (15 m) away from power and phone lines.

8 Metal Building Panel Bonding Methods

Bolt or weld building panels together, install copper straps or braided wire across seams, and ground frame.

9 Grounding Rod

Consult the National Electrical Code for specifications.

10 Windows And Doorways

Cover all windows and doorways with grounded copper screen of not more than 1/4 in (6.4 mm) mesh.

11 Overhead Door Track

Ground the track.

Figure 7-3. Correct Installation

SECTION 8 – TUNGSTEN ELECTRODE

mod2.1 1/94

NOTE ☞

For additional information, see your distributor for a handbook on the Gas Tungsten Arc Welding (GTAW) process.

Wear clean gloves to prevent contamination of tungsten electrode.

8-1. Selecting Tungsten Electrode

Table 8-1. Tungsten Size

Electrode Diameter	Amperage Range - Gas Type♦ - Polarity			
	DC – Argon – Electrode Negative/Straight Polarity	DC – Argon – Electrode Positive/Reverse Polarity	AC – Argon – Using High Frequency	AC – Argon – Balanced Wave Using High Freq.
Pure Tungsten (Green Band)				
.010”	Up to 15	*	Up to 15	Up to 10
.020”	5-20	*	5-20	10-20
.040”	15-80	*	10-60	20-30
1/16”	70-150	10-20	50-100	30-80
3/32”	125-225	15-30	100-160	60-130
1/8”	225-360	25-40	150-210	100-180
5/32”	360-450	40-55	200-275	160-240
3/16”	450-720	55-80	250-350	190-300
1/4”	720-950	80-125	325-450	250-400
2% Thorium Alloyed Tungsten (Red Band)				
.010”	Up to 25	*	Up to 20	Up to 15
.020”	15-40	*	15-35	5-20
.040”	25-85	*	20-80	20-60
1/16”	50-160	10-20	50-150	60-120
3/32”	135-235	15-30	130-250	100-180
1/8”	250-400	25-40	225-360	160-250
5/32”	400-500	40-55	300-450	200-320
3/16”	500-750	55-80	400-500	290-390
1/4”	750-1000	80-125	600-800	340-525
Zirconium Alloyed Tungsten (Brown Band)				
.010”	*	*	Up to 20	Up to 15
.020”	*	*	15-35	5-20
.040”	*	*	20-80	20-60
1/16”	*	*	50-150	60-120
3/32”	*	*	130-250	100-180
1/8”	*	*	225-360	160-250
5/32”	*	*	300-450	200-320
3/16”	*	*	400-550	290-390
1/4”	*	*	600-800	340-525

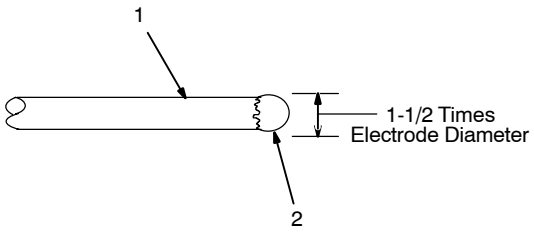
♦ Typical argon shielding gas flow rates are 15 to 35 cfh (cubic feet per hour).

*Not Recommended.

The figures listed are intended as a guide and are a composite of recommendations from American Welding Society (AWS) and electrode manufacturers.

S-0009

8-2. Preparing Tungsten



1 Tungsten Electrode

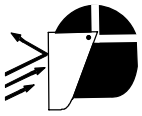
2 Balled End

Ball end of tungsten before welding by applying either an ac amperage slightly higher than what is recommended for a given electrode diameter (see Table 8-1), or a dc electrode positive amperage.

Ref. S-0161

Figure 8-1. Preparing Tungsten For AC Or DC Electrode Positive (DCEP) Welding

⚠ CAUTION



FLYING SPARKS AND HOT METAL can cause injury and start fires.

- Shape tungsten electrode only on grinder with proper guards in a safe location wearing proper face, hand, and body protection.
- Keep flammables away.

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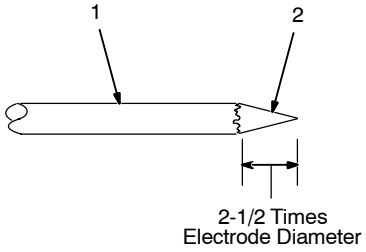
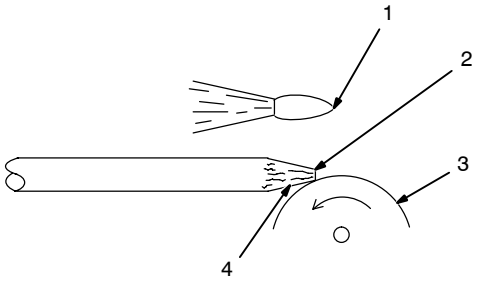


1 Tungsten Electrode

2 Tapered End

Grind end of tungsten on fine grit, hard abrasive wheel before welding. Do not use wheel for other jobs or tungsten can become contaminated causing lower weld quality.

Ref. S-0161



Ideal Tungsten Preparation – Stable Arc

1 Stable Arc

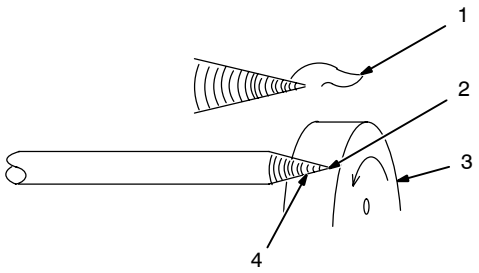
2 Flat

Diameter of this flat determines amperage capacity.

3 Grinding Wheel

4 Straight Ground

Ref. S-0162



Wrong Tungsten Preparation – Wandering Arc

1 Arc Wander

2 Point

3 Grinding Wheel

4 Radial Ground

Ref. S-0162

Figure 8-2. Preparing Tungsten For DC Electrode Negative (DCEN) Welding

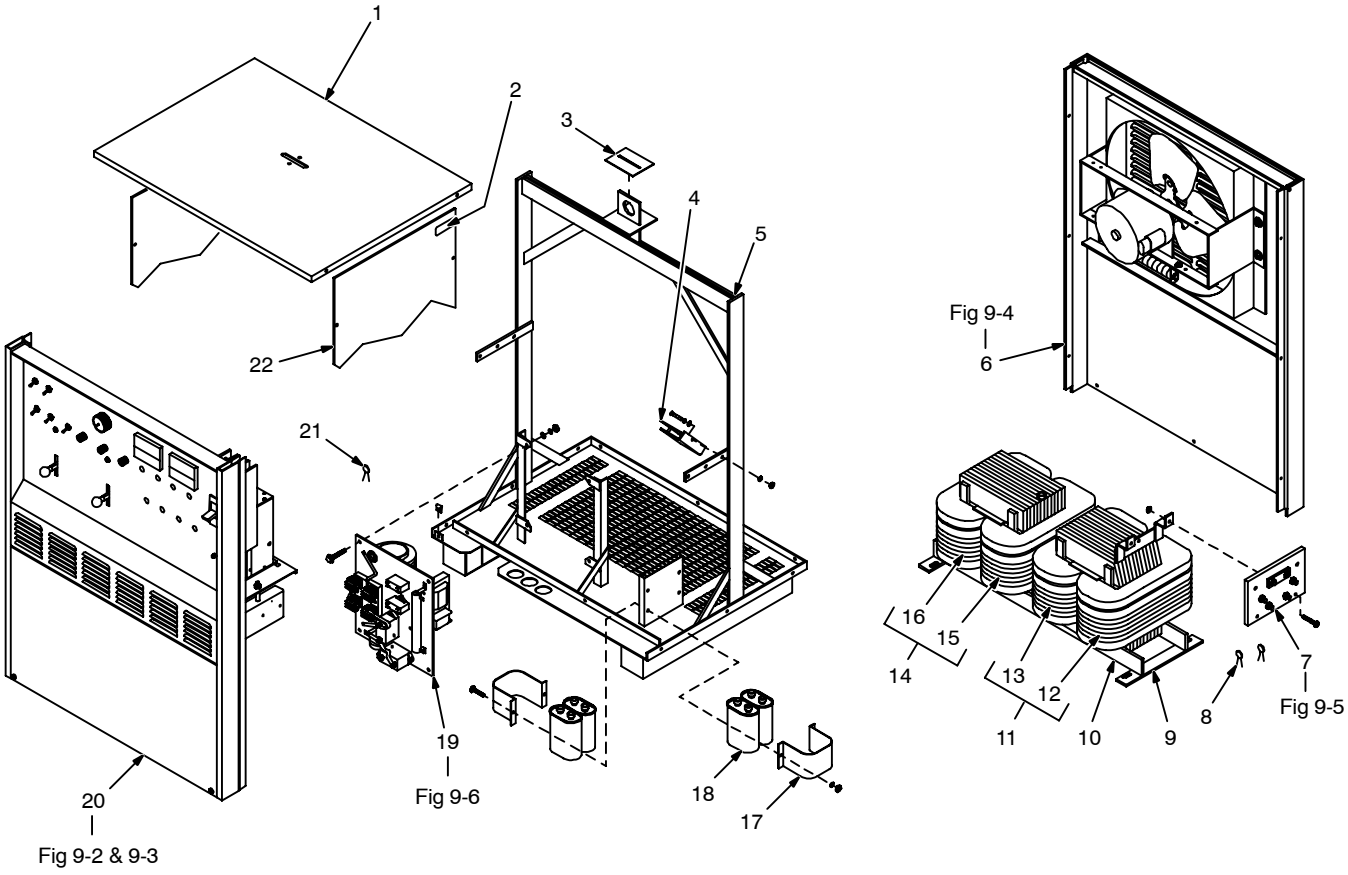


Figure 9-1. Main Assembly

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 9-1. Main Assembly	
1		039 244	COVER, top	1
1		♦052 302	COVER, top w/programmer mtg	1
2		109 035	LABEL, warning electric shock can kill etc.	1
3		026 627	GASKET, lifting eye cover	1
4	HA1,HD1	059 641	SENSOR, current	1
5		135 361	BASE	1
6		Fig 9-4	PANEL, rear w/components	1
7	TE1	059 095	TERMINAL ASSEMBLY, pri triple voltage (Fig 9-5)	1
8	C1,3	112 557	CAPACITOR	2
9		135 508	BAR, mtg transformer/reactor	2
10		000 194	BAR, stl .375 x 2.000 x 29.750	2
		022 113	BAR, stl .250 x 1.000 x 5.875	2
11	T1	145 268	TRANSFORMER, pwr main 200(208)/230/460 (consisting of)	1
12		139 543	COIL, pri/sec RH	1
13		139 542	COIL, pri/sec LH	1
11	T1	145 267	TRANSFORMER, pwr main 230/460/575 (consisting of)	1
12		139 545	COIL, pri/sec RH	1
13		139 544	COIL, pri/sec LH	1
14	Z1	059 113	REACTOR, square wave (consisting of)	1
15		059 101	COIL, rear sq wave RH	1
16		059 102	COIL, rear sq wave LH	1
17		025 141	BRACKET, mtg capacitor	2
18	C2	114 610	CAPACITOR, polyp met film 30uf 480VAC	4
19		108 323	HF PANEL, (Fig 9-6)	1
20		Fig 9-2 & 9-3	PANEL, front w/components	1
21	C16	009 062	CAPACITOR	1
22		+039 248	PANEL, side	2
		140 508	KIT, label	1

♦OPTIONAL
+When ordering a component originally displaying a precautionary label, the label should also be ordered.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

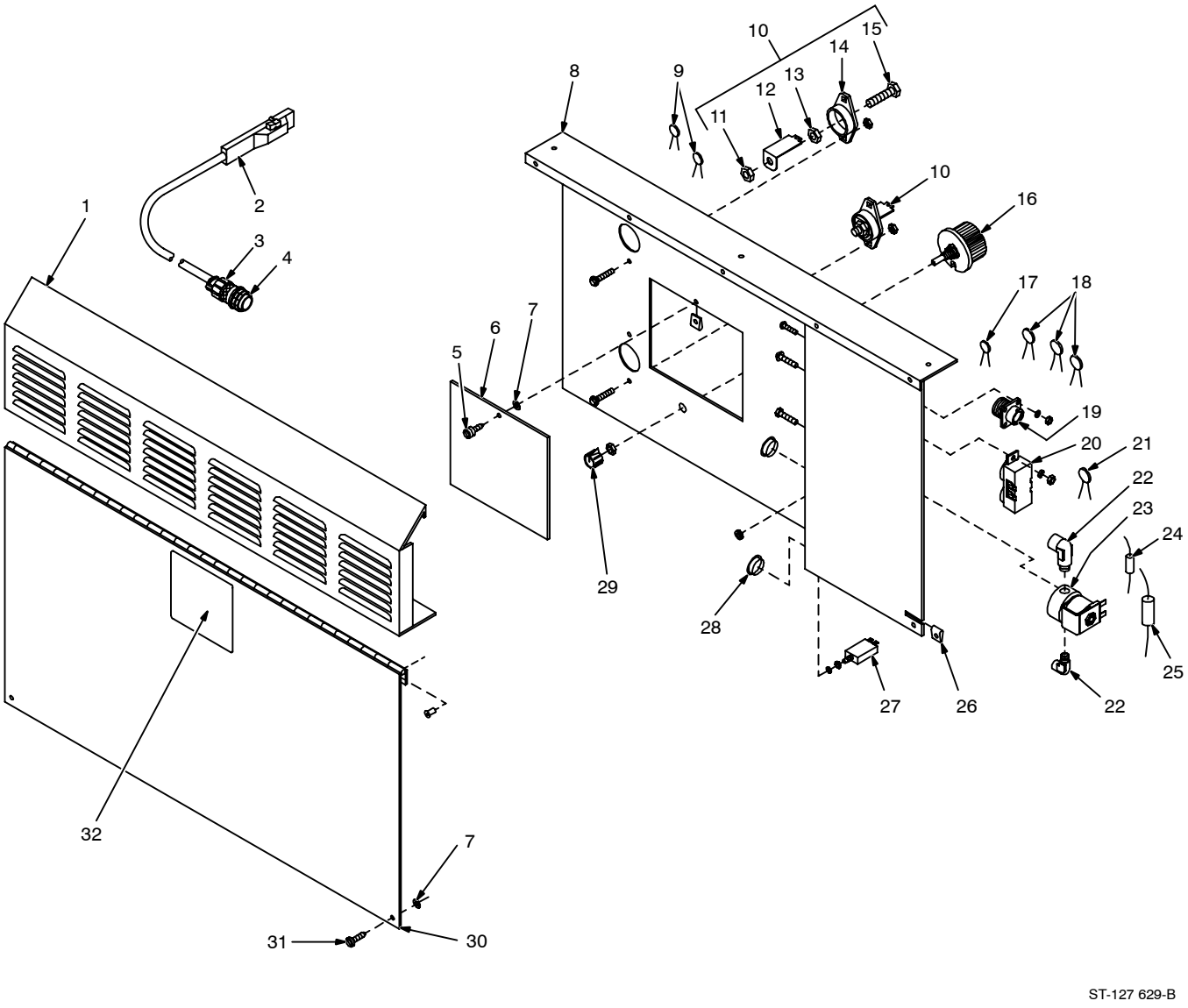


Figure 9-2. Panel, Front (Lower Section) w/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 9-2. Panel, Front (Lower Section) w/Components (Fig 9-1 Item 20)	
1		003 045	PANEL, front louvered	1
2		009 835	SWITCH, w/leads	1
3		039 273	PLUG, 5 pin MS-3106A-16S-8P	1
4		039 685	CLAMP, cable AN-3057-8	1
5		602 358	FASTENER, scr knrl hd No. 2	1
6		052 467	DOOR, access HF	1
7		010 855	RETAINER, screw No. 2	3
8		130 171	PANEL, front	1
9	C15	136 736	CAPACITOR	1
10		039 047	TERMINAL, pwr output red (consisting of)	2
11		601 879	NUT, stl hex full fnsh .500-13	1
12		039 044	BUS BAR, term bd	1
13		601 880	NUT, stl hex jam .500-13	1
14		039 049	TERMINAL BOARD, red	1
15		601 976	SCREW, cap stl hexhd .500-13 x 1.500	1
16	R20	605 828	RHEOSTAT, WW 50W 1.5 ohm	1
17	C24	144 298	LEAD ASSEMBLY, elect	1
18	C20	144 296	LEAD ASSEMBLY, elect	1
18	C21	144 297	LEAD ASSEMBLY, elect	1
18	C25	144 295	LEAD ASSEMBLY, elect	1
19	RC2	143 976	RECEPTACLE w/TERMINALS, (consisting of)	1
		079 534	TERMINAL, female 1skt 18-14 wire	14
		134 734	HOUSING, term plug 14cont Amp 213571-2	
		134 731	TERMINAL, male 1 pin 18-14 wire Amp 213603-1	
		079 739	CLAMP, cable strain relief sz 17 Amp 206322-2	
20	RC1	604 176	RECEPTACLE, str dx grd 2P3W 15A 125V	1
		073 690	CAP, P & S 5266DF	
21	C4	135 664	CAPACITOR	1
22		010 296	FITTING, hose brs elb M 1/4NPT x .625-18RH	2
23	GS1	003 538	VALVE, 115VAC 2 way 1/4 IPS port 1/8 orf	1
24	R9	030 761	RESISTOR, C 1W 10 ohm	1
25	C6	028 294	CAPACITOR, polye met film 1uf 250VDC	1
26		605 670	NUT, speed 12-24	3
27	CB1	093 995	CIRCUIT BREAKER, man reset 1P 15A 250VAC	1
28		070 371	BLANK, snap-in nyl 1.093/1.125mtg hole	2
29		097 922	KNOB, pointer .875dia x .250 ID	1
30		+003 043	DOOR, access front	1
31		078 034	FASTENER, screw sltd hd .736 lg	2
32		134 327	LABEL, warning general precautionary	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

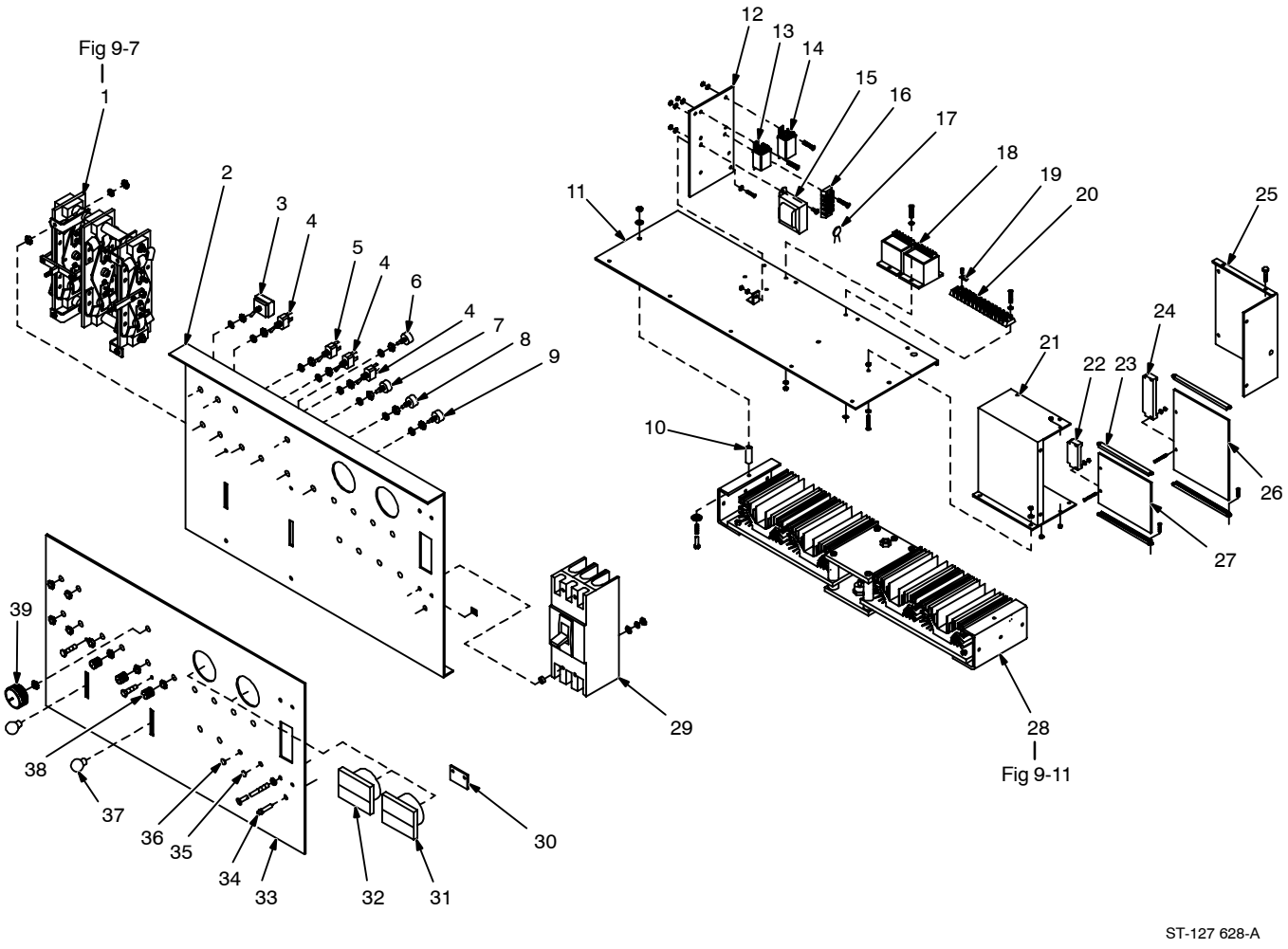


Figure 9-3. Panel, Front (Upper Section) w/Components

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 9-3. Panel, Front (Upper Section) w/Components (Fig 9-1 Item 20)	
1	S5,7	059 081	SWITCH, polarity/selector (Fig 9-7)	1
2			PANEL, front (Fig 9-2 Item 8)	1
3	S4	011 622	SWITCH, tgl 3PDT 15A 125VAC	1
4	S10-12	011 609	SWITCH, tgl SPDT 15A 125VAC	3
5	S3	011 610	SWITCH, tgl SPDT 15A 125VAC	1
6	R1	072 462	POTENTIOMETER, w/shaft lock (consisting of)	1
		072 590	. . . . LOCK, shaft pot .375-32 x .250dia shaft	1
7	R14	035 897	POTENTIOMETER, C sltd sft 1/T 2W 1000 ohm	1
8	R13	030 109	POTENTIOMETER, C sltd sft 1/T 2W 5000 ohm	1
9	R15	028 769	POTENTIOMETER, C sltd sft 1/T 2W 750K ohm	1
10		007 097	TUBING, stl .500 OD x .060 x 1.437	2
11		106 556	BAFFLE, panel front	1
12		059 152	PANEL, mtg components	1
13	CR2	000 174	RELAY, encl 24VAC 3PDT	1
	SN1	110 079	SNUBBER, polye MF .5uf 200VDC	1
14	CR1	052 251	RELAY, volt sense 100V DPDT	1
15	T2	035 759	TRANSFORMER, control mintr 115/36VCT	1
16	2T	038 081	BLOCK, term 30A 4P	1
17	C23	139 204	CAPACITOR,	1
18	FC1,2	110 142	PULSE MODULE	2
19		601 219	LINK, jumper term blk 20A	4
20	1T	038 833	BLOCK, term 20A 13P	1
21		107 794	ENCLOSURE, circuit card	1
22	PLG20	039 347	TERMINAL, hdr 17skt	1
		003 168	TERMINAL, frict fem mintr 20-18 wire	17
23		035 506	GUIDE, circuit card	4
24	PLG3	039 358	TERMINAL, hdr 35skt	1
		003 168	TERMINAL, frict fem mintr 20-18 wire	35
25		000 020	PANEL, encl circuit card	1
26	PC1	110 459	CIRCUIT CARD, control	1
27	PC2	052 790	CIRCUIT CARD, HF & post-flow timer	1
28	SR1	119 939	RECTIFIER, SCR main (Fig 9-11)	1
29	S1	059 518	CIRCUIT BREAKER, 2P 225A 600VAC	1
30		080 309	CIRCUIT CARD, meter calibration	1
31	A	059 494	METER, amp ac/dc 0-750 scale	1
32	V	004 189	METER, volt ac/dc 0-100 scale	1
33			NAMEPLATE, (order by model and serial number)	1
34	PL1	027 645	LIGHT, indicator 125VAC red lens	1
35		107 983	BLANK, snap-in nyl .500mtg hole	3
36		119 951	BLANK, snap-in nyl .437mtg hole	5
37		019 603	KNOB, ball 1.250 OD w/.250-20fthrd	2
38		097 922	KNOB, pointer	3
39		097 926	KNOB, pointer 2.375dia x .250 ID	1

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
			Figure 9-4. Panel, Rear w/Components (Fig 9-1 Item 6)	
1		020 729	CHAMBER, plenum 18in	1
2		032 606	BLADE, fan 18 in 3wg 22deg .500 bore CW	1
3		059 068	PANEL, rear	1
4	R10	097 459	RESISTOR, WW fxd 375W 20 ohm	1
5	FM	032 605	MOTOR, cap perm SP 1/4 hp 235VAC 1625RPM	1

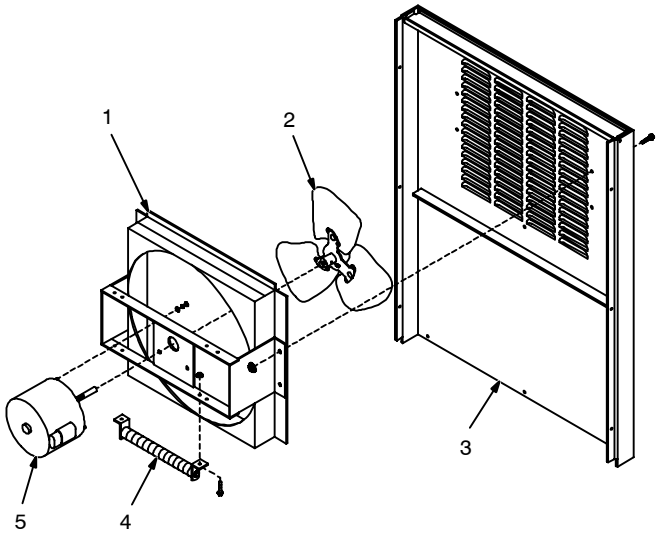


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Figure 9-4. Panel, Rear w/Components

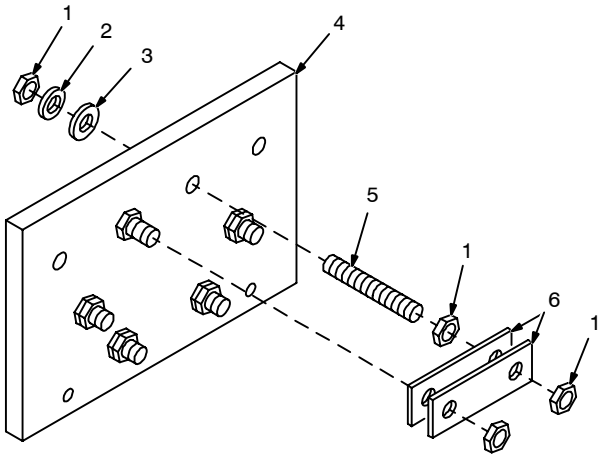

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Figure 9-5. Terminal Assembly, Pri

Item No.	Part No.	Description	Quantity
	059 095	**Figure 9-5. Terminal Assembly, Pri (Fig 9-1 Item 7)**	
1	601 838	NUT, brs hex .375-16 jam	22
2	602 221	WASHER, lock stl intl tooth .375	8
3	010 910	WASHER, flat stl SAE .375	8
4	059 050	TERMINAL BOARD, pri	1
5	038 804	STUD, brs .375-16 x 2.500	8
6	038 898	LINK, terminal connecting	2

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
		108 323	**Figure 9-6. HF Panel (Fig 9-1 Item 19)**	
1		601 838	NUT, brs hex .375-16 jam hvy	4
2		602 243	WASHER, flat stl std .375	4
3	T4	033 373	COIL, coupling air HF	1
4	T3	074 398	TRANSFORMER, high voltage 115V pri 3600V sec 30mA	1
5		010 910	WASHER, flat stl SAE .375	2
6		603 737	SCREW, mach brs rdh .375-16 x 1.750	2
7		016 601	MOUNTING BOARD, component HF	1
8		605 742	CLIP, mtg resistor .500 ID	2
9	R11	083 784	RESISTOR, WW fxd 100W 10 ohm	1
10	C13	106 935	CAPACITOR, polyp film 10uf 250VAC	2
11	C14,17	096 761	CAPACITOR, mica .002uf 10000VDC	2
12		010 885	STRIP, conductor	4
13		111 181	LINK, connecting	1
14		020 623	SPARK GAP ASSEMBLY, (consisting of)	1
15		020 622	. . . . HOLDER, points	4
16	G	*020 603	. . . . POINT, spark gap	4
17		095 621	. . . . BASE, spark gap	1
18		601 835	NUT, brs hex 10-32	6
19		602 042	SCREW, mach brs rdh 10-32 x 1.000	1
20		038 887	STUD, pri bd brs 10-32 x 1.375	2

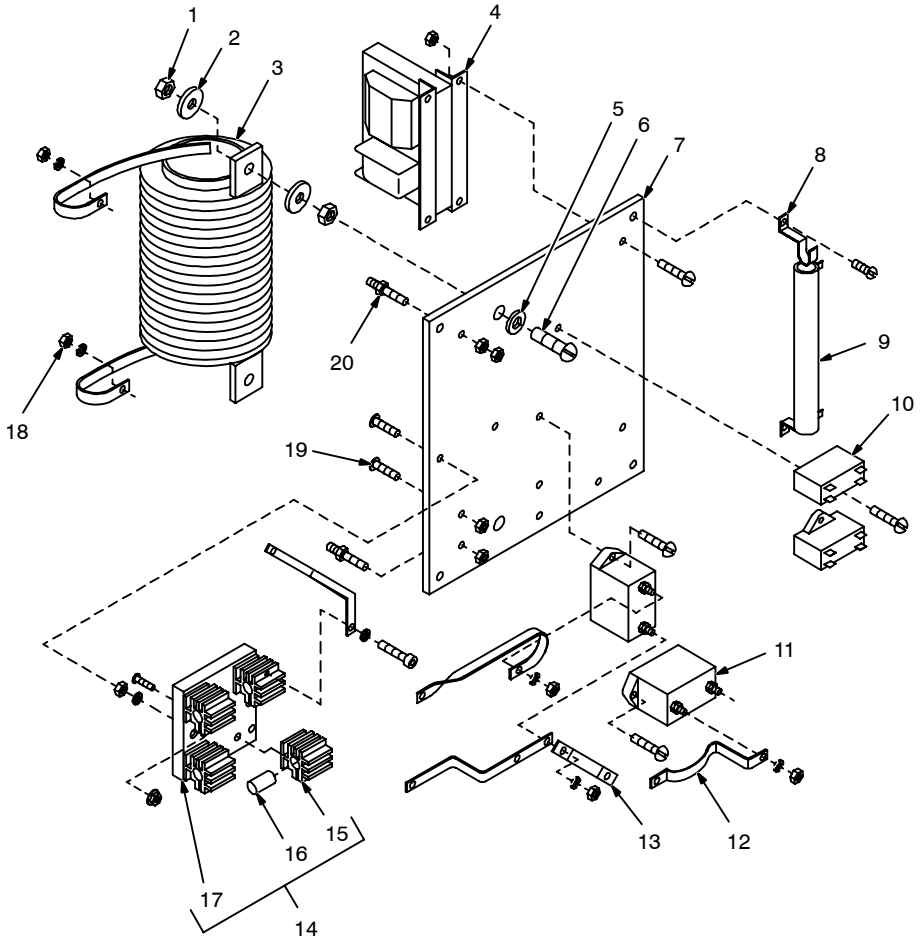

Figure 9-6. HF Panel

*Recommended Spare Parts.
BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
		059 081	**Figure 9-7. Switch, Range/Polarity/Selector (Fig 9-3 Item 1)**	
1		048 314	STUD, stl .250-20 x 9.500	2
2	S5	059 084	CONTACT BOARD ASSEMBLY, switch selector ac/dc (Fig 9-8)	1
3		025 181	TUBING, stl .625 OD x 12ga x .500	6
4		104 935	BRACKET, mtg switch	2
5		020 484	TUBING, stl .625 OD x 12ga x .250	2
6	S5	059 083	CONTACT BOARD ASSEMBLY, switch selector ac/dc (Fig 9-9)	1
7		003 230	TUBING, stl .625 OD x 12ga x 2.625	2
8		♦021 193	GUIDE, contact	2
9		010 086	SPACER, polarity switch	2
10	S7	059 082	CONTACTOR BOARD ASSEMBLY, switch polarity (Fig 9-10)	1
11		004 696	BRACKET, mtg switch	2
12		♦♦004 267	LINK, jumper switch (ac/dc)	1
13		♦♦080 346	LINK, jumper switch	1
14		080 348	HANDLE, switch	1

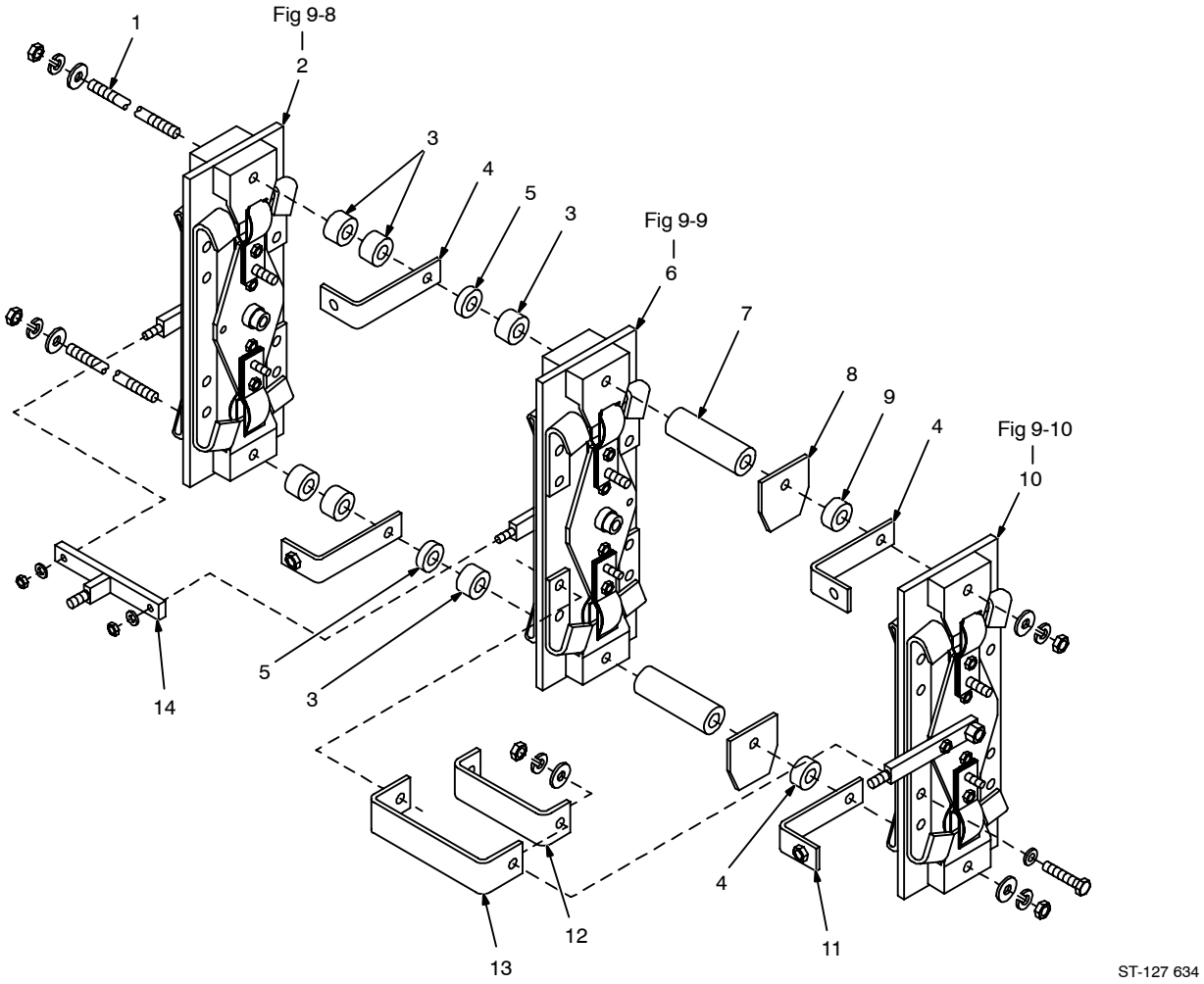

Figure 9-7. Switch, Range/Polarity/Selector

♦ Item part of 059 082 polarity switch contact board assembly.

♦♦ Items are not part of 059 081 parts list.

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Part No.	Description	Quantity
	059 084	**Figure 9-8. Contact Board Assembly, Switch Selector AC/DC (Fig 9-7 Item 2)**	
1	070 318	CONTACT BOARD, movable switch (consisting of)	1
2	103 632	PLATE, switch tgl	1
3	039 257	HANDLE, switch	1
4	011 645	CONTACT ASSEMBLY, movable switch (consisting of)	2
5	011 074	SPRING, pressure contact switch	1
6	011 953	CONTACT, switch	2
7	011 075	SPRING, pressure contact switch	1
8	103 633	BUS BAR, shorting switch polarity	2
9	011 950	CONTACT, switch	2
10	011 948	GUIDE, contact movable switch	4
11	011 951	CONTACT, switch	2
12	070 317	CONTACT BOARD ASSEMBLY, movable switch (consisting of)	1
13	103 632	PLATE, switch tgl	1
14	011 645	CONTACT ASSEMBLY, movable switch (consisting of)	1
15	011 075	SPRING, pressure contact switch	1
16	011 953	CONTACT, switch	2
17	011 074	SPRING, pressure contact switch	1
18	020 484	TUBING, stl .625 OD x 12ga x .250	1
19	024 694	BEARING, polarity switch	2
20	103 634	MOUNTING BOARD, component polarity switch	1

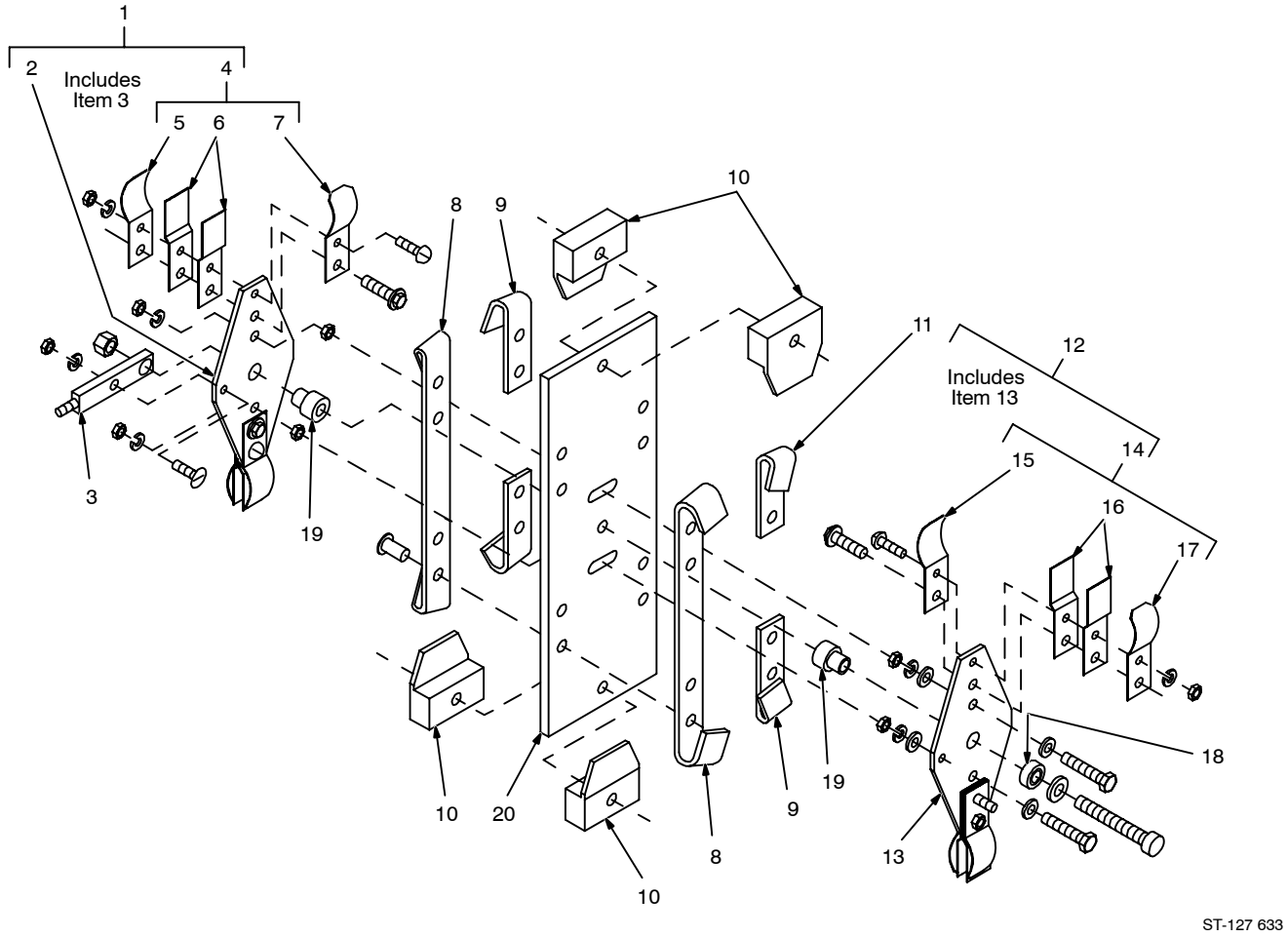

Figure 9-8. Contact Board Assembly, Switch Selector AC/DC

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Part No.	Description	Quantity
	059 083	**Figure 9-9. Contact Board Assembly, Switch Selector AC/DC (Fig 9-7 Item 6)**	
1	070 318	. . CONTACT BOARD, movable switch (consisting of)	1
2	011 645	. . . . CONTACT ASSEMBLY, movable switch (consisting of)	2
3	011 075	. . . . . SPRING, pressure contact switch	1
4	011 074	. . . . . SPRING, pressure contact switch	1
5	011 953	. . . . . CONTACT, switch	2
6	103 632	. . . . PLATE, switch tgl	1
7	039 257	. . . . HANDLE, switch	1
8	011 951	. . CONTACT, switch	4
9	011 950	. . CONTACT, switch	4
10	011 948	. . GUIDE, contact movable switch	4
11	070 317	. . CONTACT BOARD ASSEMBLY, movable switch (consisting of)	1
12	103 632	. . . . PLATE, switch tgl	1
13	011 645	. . . . CONTACT ASSEMBLY, movable switch (consisting of)	2
14	011 075	. . . . . SPRING, pressure contact switch	1
15	011 953	. . . . . CONTACT, switch	2
16	011 074	. . . . . SPRING, pressure contact switch	1
17	020 484	. . TUBING, stl .625 OD x 12ga x .250	1
18	024 694	. . BEARING, polarity switch	2
19	103 634	. . MOUNTING BOARD, component polarity switch	1

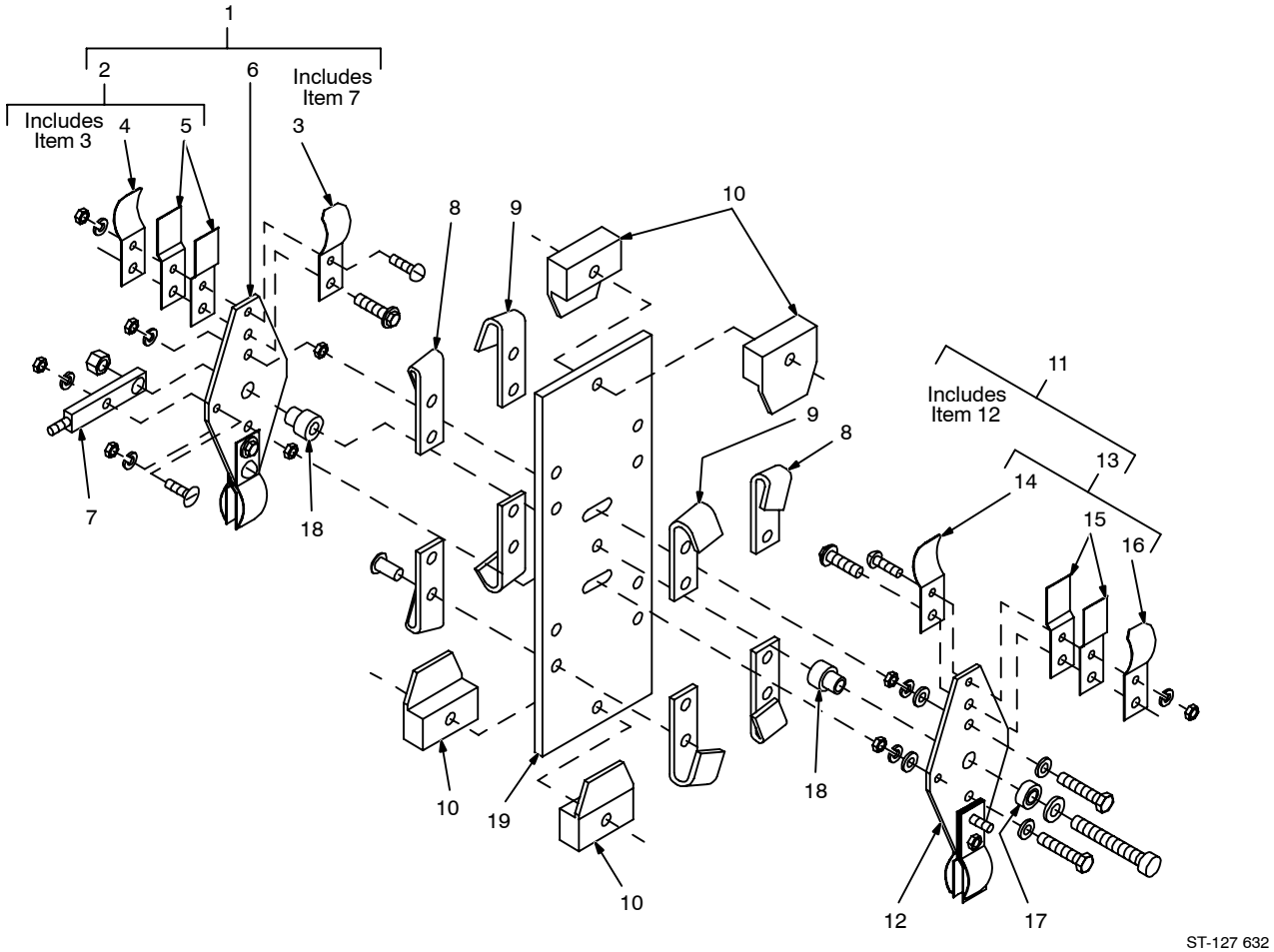

Figure 9-9. Contact Board Assembly, Switch Selector AC/DC

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Part No.	Description	Quantity
	059 082	**Figure 9-10. Contact Board Assembly, Switch Polarity (Fig 9-7 Item 10)**	
1	070 317	. . CONTACT BOARD ASSEMBLY, movable switch (consisting of)	1
2	011 645	. . . . CONTACT ASSEMBLY, movable switch (consisting of)	2
3	011 075	. . . . . SPRING, pressure contact switch	1
4	011 074	. . . . . SPRING, pressure contact switch	1
5	011 953	. . . . . CONTACT, switch	2
6	103 632	. . . . PLATE, switch tgl	1
7	103 633	. . BUS BAR, shorting switch polarity	4
8	103 634	. . MOUNTING BOARD, component polarity switch	1
9	011 948	. . GUIDE, contact movable switch	2
10	070 316	. . CONTACT BOARD ASSEMBLY, movable switch (consisting of)	1
11	010 805	. . . . HANDLE, switch	1
12	103 632	. . . . PLATE, switch tgl	1
13	011 645	. . . . CONTACT ASSEMBLY, movable switch (consisting of)	2
14	011 075	. . . . . SPRING, pressure contact switch	1
15	011 953	. . . . . CONTACT, switch	2
16	011 074	. . . . . SPRING, pressure contact switch	1
17	024 694	. . BEARING, polarity switch	2
18	020 484	. . TUBING, stl .625 OD x 12ga x .250	1

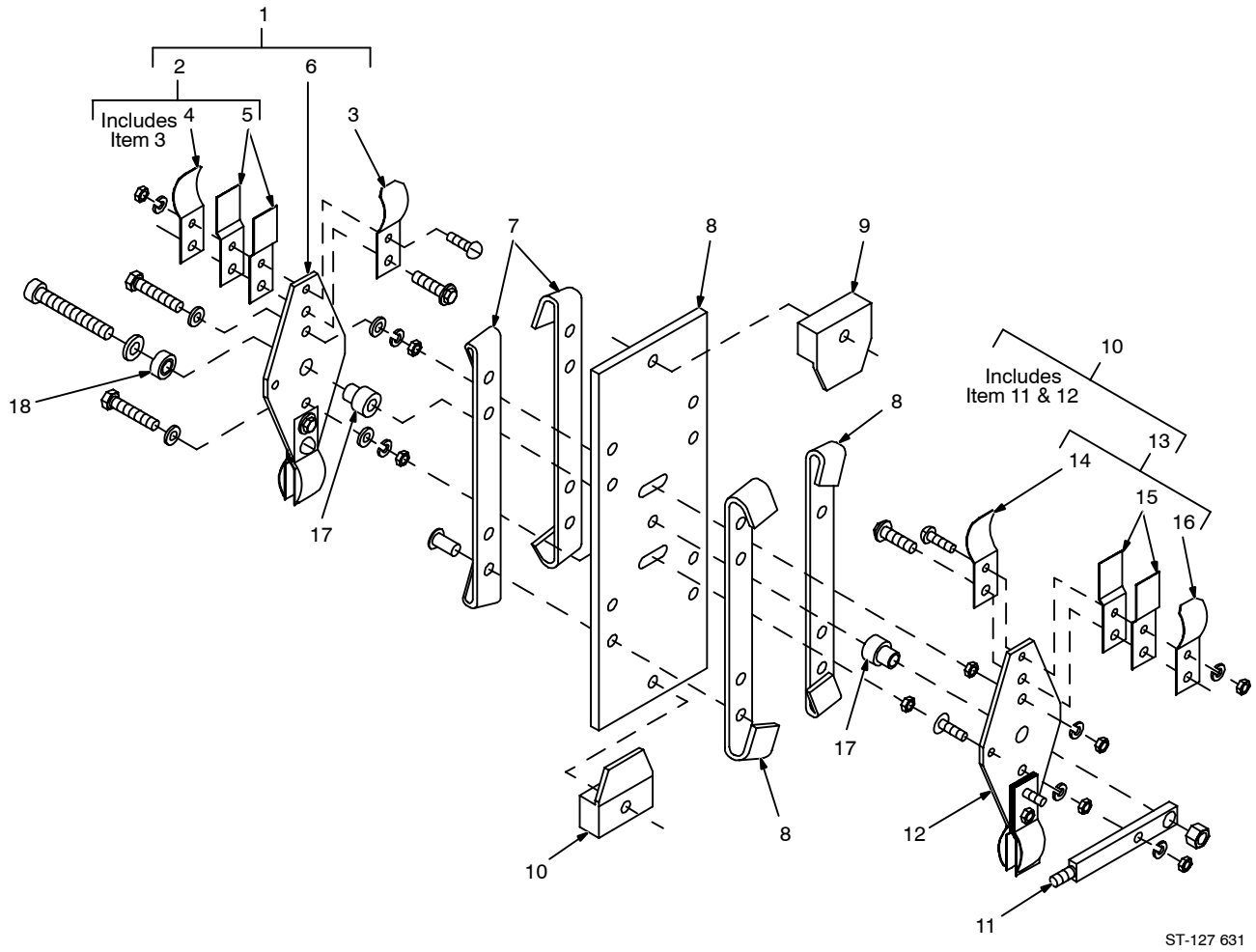

Figure 9-10. Contact Board Assembly, Switch Polarity

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
	SR1	**119 939**	**Figure 9-11. Rectifier, SCR Main (Fig 9-3 Item 28)**	
1		083 884	CLAMP, thyristor rectifier 4.250	4
2		059 075	HEAT SINK, rectifier snowflake 5.500	4
3		028 516	PIN, spring CS .125 x .250	8
4	SCR1-4	112 941	THYRISTOR, SCR 700A 300V	4
5		010 311	CLAMP, nyl .750 clamp dia x .500 wide	4
6	C7-10,R3-6	044 468	SUPPRESSOR, .5uf 200V	4
7	D1	023 178	DIODE, rect 275A 300V RP	2

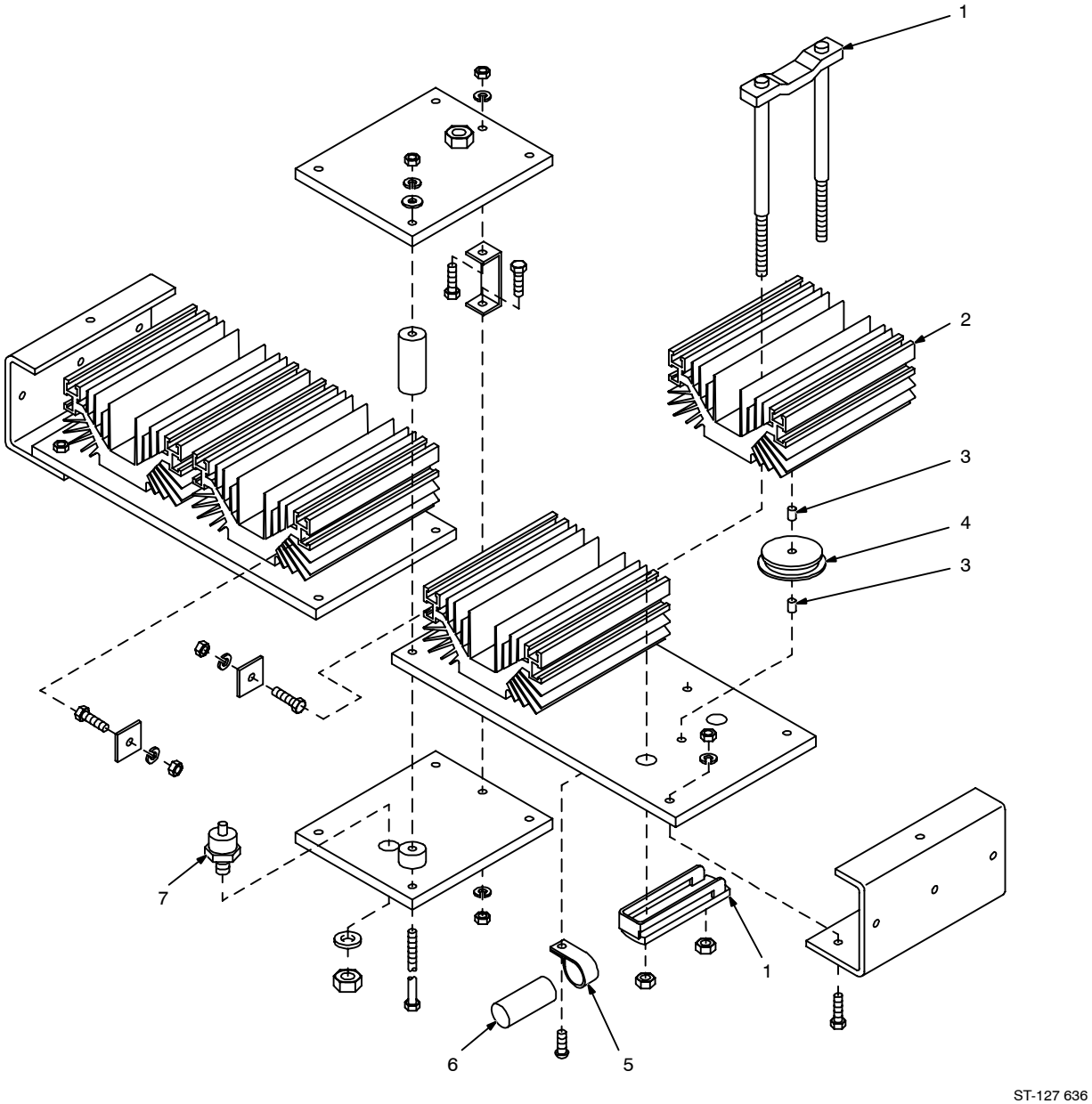

Figure 9-11. Rectifier, SCR Main

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

OPTIONS AND ACCESSORIES

NO. 17 RUNNING GEAR
(#004 563)
Three 8 in. (203 mm) rubber–tired wheels with towing handle and rack for two cylinders.

PREFLOW TIMER
(#041 172 Factory**)**
(#041 173 Field**)**
Provides 0 to 15 seconds of gas preflow time. On/Off switch included.

PULSER
(#003 265 Factory**)**
(#003 266 Field**)**
For welding of thin materials. Provides heating and cooling effect of the weld puddle. Provides 0.25 to 10 pulses–per–second.

SPOT WELD TIMER
(#041 170 Factory**)**
(#041 171 Field**)**
Adjustable 0 to 5 second time control for TIG spot welding. On/Off switch included.

WATER SOLENOID VALVE
(#041 924 Field**)**
For use when **not** using a closed–loop cooling system.

REMOTE CONTROLS AND SWITCHES

RHC–14 HAND CONTROL
(#129 340)
Miniature hand control for remote current and contactor control. Dimensions: 4 in. (102 mm) x 4 in. (102 mm) x 3–1/4 in. (82 mm). Includes 20 ft. (6 m) cord and 14–pin plug.

RFC–14 FOOT CONTROL
(#129 339)
Heavy duty foot current and contactor control. Includes 20 ft. (6 m) cord and 14–pin plug.

RFC–E FOOT CONTROL
(#042 856)
Lightweight, compact foot control. Includes 15 ft. (4.6 m) cord and 14–pin plug.

RMLS–14 CONTACTOR SWITCH
(#129 337)
Push forward for maintained contact and back for momentary contact. Includes 20 ft. (6 m) cord and 14–pin plug.

RCC–14 REMOTE CONTACTOR AND CURRENT CONTROL
(#151 086)
Rotary motion fingertip control. Fastens to TIG torch using two Velcro strips. Includes 28 ft. (8.5 m) cord and plug.

ADAPTER CORD
(#041 947)
1 ft. (305 mm) cord with 14–pin plug to 5–socket receptacle for use with 5–pin remote controls.

EXTENSION CORDS

For 14–Pin Remote Controls

(#122 972)	10 ft. (3 m)
(#122 973)	25 ft. (7.6 m)
(#122 974)	50 ft. (15.2 m)
(#122 975)	75 ft. (22.9 m)

WATER COOLANT SYSTEMS
For detailed information on Coolant Systems, refer to Literature Index No. AY/7.2.

RADIATOR 1A
(#042 492)
1/4 HP, 115 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

RADIATOR 2A
(#042 493)
1/4 HP, 230 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

WATERMATE™ 1A
(#042 495)
1/4 HP, 115 VAC, 50/60 Hz motor. 1.5 gal. (5.7 L) capacity.

COOLMATE™ 4
(#042 288)
1/4 HP, 115 VAC, 50/60 Hz motor. 4 gal. (15 L) capacity.

TIG HOSE HOOK–UP KIT THK–1
(#128 065)
Provides the necessary hoses and hardware to connect water–cooled torches to a power source and coolant system.

MILLER COOLANT
(For freezing protection)
(#128 705)
1 gal. (3.8 L). Contains 35% pure ethylene glycol and 65% deionized water.

For TOTAL TIG™ system, select one each of the following items:
- Welding power source
- TIG torch (listed below)
- TIG kit (see TIG kits listed below)
- Coolant system (if using water–cooled torch)
- Remote control

200 AMP AIR–COOLED TORCHES

MT–26, 200 AMPS (MAX.)
For hand–held manual applications

MT–26 RIGID HEAD MODELS
(#116 125) MT–26–12–2
(#116 126) MT–26–25–2
Includes torch body with handle, 300HS heat shield, short backcap, and cable assembly.

250 AMP WATER–COOLED TORCHES

Note: Water–cooled torches require a power cable adapter (#116 228).

MT–20, 250 AMPS (MAX.)
For hand–held manual applications
The MT–20 features a “bonded” tri–flex cable assembly.

MT–20 MODELS
(#116 147) MT–20–12
(#116 148) MT–20–25
Includes torch body with handle, 200HS heat shield, medium backcap, and cable assembly.

OPTIONS AND ACCESSORIES

350 AMP WATER–COOLED TORCHES

MT–18, 350 AMPS (MAX.)
For hand–held manual applications
The MT–18 features a “bonded” tri–flex cable assembly.

MT–18 MODELS

(#116 151) MT–18–12
(#116 152) MT–18–25
Includes torch body with handle, 300HS heat shield, long backcap, and cable assembly.

WATER–COOLED AUTOMATIC TORCHES

MAT–13, 400 AMPS (MAX.)
Continuous Duty Cycle

The MAT–13 water–cooled automatic torch is equipped with fail–safe hose connections which require no wire or crimping. The torch is face–plate mounted, allowing use in limited space. Right angle fittings are used, allowing in–line routing of hose and cables. The unique backcap adjustment allows adjusting the tungsten during operation. Uses dual power cables for increased current capacity.

MAT–13 MODELS

(#117 344) MAT–13–12
(#117 345) MAT–13–25
Includes torch body, M–HS heat shield, adjusting cap with O–rings, short backcap with O–rings, and cables and hose with fittings installed.

Note: Power cable adapter (#116 248) must also be ordered.

INSTALLATION KITS

KIT FOR 200 AMP AIR–COOLED TIG TORCH

(#129 588) 12–1/2 ft. (3.8 m) length
(#129 587) 25 ft. (7.6 m) length

Kit includes:
- Hose and hardware hook–up kit
- Consumable accessory kit — one backcap and three sizes of collets (1/16, 3/32 and 1/8 in.), collet bodies, cups, and 2% thoriated tungsten
- Regulator/flowmeter (HRF–2425)
- Ground cable with clamp (clamp rated for 350 Amps), 12–1/2 ft. (3.8 m) or 25 ft. (7.6 m) lengths to match TIG torch length

KIT FOR 250 AMP WATER–COOLED TIG TORCH

(#129 594) 12–1/2 ft. (3.8 m) length
(#129 593) 25 ft. length (7.6 m)

Kit includes:
- Hose and hardware hook–up kit
- Consumable accessory kit — one backcap and three sizes of collets (1/16, 3/32 and 1/8 in.), collet bodies, cups, and 2% thoriated tungsten
- Regulator/flowmeter (HRF–2425)
- Ground cable with clamp (clamp rated for 350 Amps), 12–1/2 ft. (3.8 m) or 25 ft. (7.6 m) lengths to match TIG torch length
- Power cable adapter

KIT FOR 350 AMP WATER–COOLED TIG TORCH

(#129 592) 12–1/2 ft. (3.8 m) length
(#129 591) 25 ft. (7.6 m) length

Kit includes:
- Hose and hardware hook–up kit
- Consumable accessory kit — one backcap and three sizes of collets (1/16, 3/32 and 1/8 in.), collet bodies, cups, and 2% thoriated tungsten
- Regulator/flowmeter (HRF–2425)
- Ground cable with clamp (clamp rated for 350 Amps), 12–1/2 ft. (3.8 m) or 25 ft. (7.6 m) lengths to match TIG torch length
- Power cable adapter